Modelling and Forecasting Foreign Debt Using ARIMA Model: The Zambian Case from 2022 to 2035

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***Abstract*: The study sought to model and forecast Zambian Government foreign debt from 2022 to 2035 using Autoregressive Integrated Moving Average Model. The secondary data of time series during the period of 1973 to 2021 on Zambia's foreign debt are used as the basis of forecasting for the next 15 years by using ARIMA (Autogressive Integrated Moving Average) Model. The ARIMA (1, 1, 2) model was used due to its accuracy, mathematical soundness, and flexibility, thanks to the inclusion of AR and MA terms over a regression analysis. The results showed that ARIMA (1, 1, 2) is an adequate model which best fits foreign debt time series datadue to the smaller deviations in the mean absolute percentage error and mean square error and its errors are smaller than Moving Average (MA), Generalized Autoregressive Conditional Heteroskedasticity Model (GARCH), Simple Exponential Smoothing (SES), Error, Trend and seasonal model (ETS), Double Exponential Smoothing (DES), Seasonal Autoregressive Integrated Moving Average (SARIMA), Vector Autoregressive Model (VAR), Vector Error Correction Model (VECM), Threshold Autoregressive model (TAR), Triple Exponential Smoothing (TES), hybrid ARIMA, and Artificial Neural Network Model (ANN). The results show that the value of the Zambia's foreign debt is predicted to keep increasing from 2022 to 2035 amounted to USD 80.5862 billion. The results also show that compared to government debt in 1973, within 49 years, Zambia's foreign debt is predicted to rise by 209.34%.**

I. INTRODUCTION

Since independence, the need for development programs is increasing every year in Zambia. Consequently, there is need for the Zambian government to provide sufficient funding to finance all programs for improving people's welfare. To finance these programs, the Zambian government has two main sources; taxation and debt issuance for example through government bonds (DiPeitro & Anoruo, 2012).

Government debt is closely related to government expenditure and tax revenue (Chatterjee, Bhattacharya, Taylor, & West, 2019). Meanwhile, the tax revenues, most of the time, are not in line with what has been targeted causing the government to take debt as the only option (Žaja, Kržić, & Habek, 2018). Government debt is not only a means of fundraising to finance public needs, but also an effective tool to stabilize the country's economic development, whose predictive values allow making effective management decisions at the state level and developing effective measures to improve the economic and debt situation (World Bank, 2017; World Bank, 2017). However, Charles and Shon (2018) define debt is has an amount of money borrowed by one party from another, often for making large purchases that they could not afford under normal circumstances.

Zambia's current debt crisis is not its first. The country gained independence in 1964, and had one of the strongest economies in Sub-Saharan Africa up until the mid-1970s due to a strong copper mining industry (Wulf, 1988). Beginning in 1975, copper prices began to fall drastically and Zambia's export revenue declined (Wulf, 1988). The government's balance of payments fell into disequilibrium and it mainly funded its deficits through external borrowing (Wulf, 1988). Significant amounts of its external debt were owed to multilateral institutions, primarily the International Monetary Fund (IMF) and World Bank (World Band, 2017; World Bank, 2018).

However, Zambia's external debt stock rose steadily throughout the 1980s and early 1990s, while its Gross Domestic Product (GDP) remained relatively constant throughout the same period (World Bank, 2017; World Bank, 2018). The World Bank and IMF made arrangements with Zambia for a policy reform program in 1983 (Wulf, 1988). These reforms entailed controversial economic liberalization policies that were eventually scrapped by the Zambian government in 1987 (Wulf, 1988). Therefore, the debt continued to grow in the years immediately following the attempted 1983 reforms.

In 1991, the Zambian government again sought to improve its economy through multilateral guidance, this time with the adoption of Structural Adjustment Program (Mvula, 2015). The Structural Adjustment Program was again controversial and entailed market liberalization policies and the removal of subsidies, including in the health and education sectors (Mvula, 2015). Many Zambian citizens became unable to afford government healthcare and education, and food insecurity increased (Mvula, 2015; World Bank, 2019). These austerity measures did not lead to substantial GDP growth and progress was not made on the external debt front.

Due to criticisms of the Structural Adjustment Programs and worldwide movements advocating for debt relief for low-income countries, the World Bank and International Monetary Fund began the Highly Indebted Poor Country Initiative and the Multilateral Debt Relief Initiative in Zambia at the beginning of the 21st century (IMF, 2005). These initiatives offered debt relief if Zambia implemented various reforms.

However, Zambia completed the Multilateral Debt Relief Initiative in late 2005, and subsequently received significant debt forgiveness from the multilateral institutions (African Development Bank, 2019). Zambia's foreign public and publicly guaranteed (PPG) debt stock fell from USD 7.54 billion in 2004 to just USD 2.26 billion in 2006 (World Bank, 2017). After more than two decades of crippling public debt, the country finally found itself in a sustainable debt situation. The debt stock then decreased modestly through 2010, when it stood at USD 4.25 billion, reflecting relatively sound debt management policies over this five-year period (World Bank, 2017).

In 2011, the country's debt levels started to substantially rise again, initiating the debt acquisition trend that has led to the current crisis (World Bank, 2017). By 2017, the external Public and Publicly Guaranteed (PPG) debt reached USD 22.95 billion, over USD 5 billion higher than the debt had ever been during the previous crisis (World Bank, 2017). This is not to say that this crisis is worse than the last, however, as the Zambian economy has grown substantially in the 21st century.

In 2017, the country's external PPG debt to GDP ratio was 34.3% whereas external PPG debt exceeded GDP for nearly two decades, from 1985 to 2003, during the last crisis (World Bank, 2017, 2018). There are still reasons for concern, however, as the nation's total Public and Publicly-Guaranteed (PPG) debt including domestic arrears at end-2018 was high at 73.1% of GDP (IMF Staff, 2019).

Additionally, the bulk of the external loans Zambia currently holds are non-concessional, whereas the majority of the country's external debt holdings during the end of the last crisis were concessional (World Bank, 2017). This has resulted in high debt servicing costs (27% of government expenditure in 2019) in the current crisis (Ndhlovu & Chishimba, 2019). There are also several other indicators and reports that reveal the country's current elevated risk of debt distress. In the IMF's Debt Sustainability Analysis for Zambia in 2017, the staff reported that under current policies, Zambia had a high risk of debt distress that is augmented by significant risks stemming from domestic public and/or private external debt (IMF Staff, 2017).

Zambia's credit ratings have also been on a downward trend in recent years and all three major credit rating agencies have downgraded Zambia in 2019 (Trading Economics, 2019). Zambia's current credit ratings reflect a high risk of distress. There is also less hope of receiving debt relief in the modern crisis because Zambia's current external lenders are likely to be less forgiving than the multilateral and Paris Club lenders that previously held a large portion of Zambia's public debt (Simumba, 2018). This shift away from multilateral and Paris Club creditors. The fact that a new debt crisis arose so shortly after the nation received debt relief will also discourage international help.

Although there is a concern about the failure in paying off the debt, productive foreign debt which is rightly targeted and efficient can provide a stimulus for the economic condition. Ramzan & Ahmad (2014), state that to stimulates economic growth with infrastructure and human capital resources, development in the developing countries can be financed by the foreign debt. The increase of the debt ratio to GDP and the value of government debt is the main problem in this study. Consequently, estimating or forecasting government debt can be a significant step in anticipating uncontrolled debt. Therefore, the purpose of this research paper is to forecast the value of Zambia's government foreign debt over the next five years from 2020 to 2024.

Despite the advanced mathematical tools for data forecast, choosing the appropriate method that provides adequate forecasts is one of the main tasks that arise in forecasting the amount of government debt. There are many different methods of forecasting economic information in modern statistical theory. Most of them relate to time series forecasting, without additional information, i.e., without analyzing the impact of other factors. Of course, such analyses are incomplete, but their results are often more accurate than other forecasting techniques.

Constructing an ARIMA model is one of such methods. Its main idea is that some time series are a set of random variables that depend on time, but changes in the entire time series have certain rules that can be represented by the corresponding mathematical model. When analyzing the mathematical model, one can understand the structure and characteristics of the time series more deeply and achieve optimal predictive values.

Different factors, such as GDP, inflation, industrial production index, COVID-19, Russia and Ukraine War, exchange rate, as well as other factors of the country's economic life, may influence the change in the value of the government debt indicator. Collecting, processing, and analyzing selected factors to build a multivariate regression model can be time consuming and require significant resources that do not correspond to the end result. For this reason, it is more appropriate to use time series-based methods, such as an ARIMA time series model.

Many methods can be used to model, forecast time series, and predict the foreign debt. Such models include Moving Average (MA), Generalized Autoregressive Conditional Heteroskedasticity Model (GARCH), Simple Exponential Smoothing (SES), Error, Trend and seasonal model (ETS), Double Exponential Smoothing (DES), Seasonal Autoregressive Integrated Moving Average (SARIMA), Vector Autoregressive Model (VAR), Vector Error Correction

Model (VECM), Threshold Autoregressive model (TAR), Triple Exponential Smoothing (TES), hybrid ARIMA, and Artificial Neural Network Model (ANN). The researchers used the Autoregressive Integrated Moving Average (ARIMA) model in this study. ARIMA models are used to predict future values based on past values (Zulu, Mwansa, & Wakumelo, 2022). However, in this study, the ARIMA model was used differently because the researchers wanted to predict the Zambia's foreign debt from 2022 to 2035 from 1970 to 2021.

The researchers also used the ARIMA model due to its accuracy, mathematical soundness, flexibility, errors are smaller in other models, and it can explore data in more detail by including AR and MA terms. Besides, the ARIMA model assisted in better understanding the time series and forecasting future points in the series from 2022 to 2035.

Although previous studies have shown interest in ARIMA modelling to forecast foreign debt (Fedir, Hanna & John, 2019; Fedir, Hanna, Šuleř, & Wołowiec, 2021; Navapan & Boonyakunakorn, 2017; Zhuravka, Filatova, & Aiye-dogbon, 2019), limited empirical studies are using the ARIMA (1, 1, 2) modelling techniques to forecast the foreign debt in a developing country such as Zambia. Hence, this study aimed to predict foreign debt in Zambia from the year 2022 to 2035. Policymakers, corporate and the public, including individuals, will likely make use of predictions in making informed decisions and understand the degree of foreign debt burden.

II. MODEL DEVELOPMENT

This study uses secondary data which are the data of the Zambian government debt. The Zambian government debt statistics from 1970 to 2021 data were obtained from the Current USS, World Bank, 2022. The range of data from 1970-2021 (Table 1) is the basis for forecasting Zambia's foreign debt during the period of 2021-2035. To forecast correctly, the ARIMA (Box and Jenkins) Model is applied.

ARIMA (Box and Jenkins) Model

George Box and Jenkins developed a practical approach to build ARIMA model. The Box-Jenkins methodology uses a three-step approach of model identification, model estimation and model validation and forecasting to determine the best model from a general class of ARIMA model. ARIMA model is used to fit historical time series expressed in terms of past values of itself plus current and lagged values of error term.

Once the series is confirmed to be stationary, one may proceed by tentatively choosing the appropriate order of models through visual inspection of plots, both the Autocorrelation Function (ACF) and Partial Autocorrelation Functions ($PACF$). The relevant properties are set out as follows: The series show an *AR (p)* process, if the ACF decays exponentially (either direct or oscillatory) and $PACF$ cut off after lag p. The series show a $MA\,(q)$ process, if the $PACF$ decays exponentially (either direct or oscillatory) and ACF cut off after lag q. The series show an $ARMA\,(p, q)$ process, if the $PACF$ decays exponentially (either direct or oscillatory) and ACF decays exponentially (either direct or oscillatory).

The basic equation of the AR framework is as follows (Jadevicius and Huston, 2015; Stevenson, 2007; Al-Shiab, 2006; Zulu, Mwansa, & Wakumelo, 2022):

$$Y_t = \beta_0 + \beta_1 Y_{t-1} + \beta_2 Y_{t-2} + \cdots + \beta_p Y_{t-p} + \varepsilon_t \qquad (1)$$

Where; Y_{t-1} dependent variable; Y_{t-1}, Y_{t-2}, Y_{t-p} independent variables of the lag (lag) of the dependent variable; ε_t error term; and p; AR level.

The basic equation of the MA framework is written as follows (Jadevicius & Huston, 2015; Al-Shiab, 2006; Balli & Elsamadisy, 2012):

$$Y_t = \beta_0 + \beta_1 \varepsilon_{t-1} + \beta_2 \varepsilon_{t-2} + \cdots \beta_q \varepsilon_{t-q} + \varepsilon_t \qquad (2)$$

Where; ε_{t-1} is dependent variable; ε_{t-1}, ε_{t-2}, ε_{t-2}, ε_{t-q} independent variable of lags (lag) of the dependent variable; ε_t error term; and q; MA level.

The ARIMA model combines the AR and MA models in the following equations (Jadevicius & Huston, 2015; Stevenson, 2007; Al-Shiab, 2006; Iskandar, et al, 2018; Balli & Mousa, 2012; Zulu, Mwansa, & Wakumelo, 2022):

$$Y_t = \beta_0 + \beta_2 Y_{t-1} + \beta_2 Y_{t-2} + \cdots + \beta_p Y_{t-p} + \varepsilon_t + \beta_1 \varepsilon_{t-1} + + \beta_2 \varepsilon_{t-2} + \cdots \beta_q \varepsilon_{t-q} + \varepsilon_t \qquad (3)$$

In this study, the researchers followed the Box-Jenkins (B-J) methodology to analyse data which calls for the following three steps:

1. Model Identification
2. Model Estimation, and
3. Model Validation and Forecasting

Table1: Zambia's Foreign Debt Data from 1973 to 2021

Year	USD(Billions)
1973	1.03
1974	1.2
1975	1.68
1976	1.89
1977	2.34
1978	2.58
1979	3.04
1980	3.25
1981	3.61
1982	3.66
1983	3.75
1984	3.75
1985	4.49
1986	5.63
1987	6.48
1988	6.69
1989	6.55
1990	6.9
1991	6.96

1992	6.7
1993	6.48
1994	6.81
1995	6.96
1996	7.06
1997	6.66
1998	6.87
1999	5.95
2000	5.81
2001	6.19
2002	6.67
2003	6.87
2004	7.54
2005	5.37
2006	2.26
2007	2.73
2008	2.95
2009	3.65
2010	4.25
2011	4.97
2012	5.72
2013	6.29
2014	9.19
2015	11.78
2016	15.22
2017	22.95
2018	23.53
2019	27.73
2020	30.05
2021	31.74

III. RESULTS AND DISCUSSIONS

This section presents the analysis and discussions of the study. Typically, effective fitting of Box-Jenkins models requires at least a moderately long series. Zulu, Mwansa and Wakumelo (2022) recommends at least 50 observations. Many others would recommend at least 100 observations. For the current study, secondary data from the the Current USS, World Bank, 2022 website has been selected for analysis. The data covers the period 1973 to 2021, thereby giving a total of 49 observations. The data collected was called into Minitab version 18 to perform the necessary analysis. The first data set is used for model identification, second is model estimation, and the third set for model validation and forecasting.

Step 1: Model Identification

The first stage involves checking the stationarity of the series through visual examination and formal statistical tools. A point to be noted at this point is that stationarity is a prerequisite for applying Box-Jenkins method. For the current study stationarity will be checked through time series plot of Zambia's foreign debt along with scatter plot, time series plot, series Correlogram-Autocorrelation Function (ACF) plot, and Partial Autocorrelation Function (PACF) plot.

In order to forecast Zambia's foreign debt from 2022 to 2035, a time series analysis was carried out for the given data shown in Table 1 above. However, the scatter plot of the time series data against time periods from 1998 to 2022 is given in Figure 1 below.

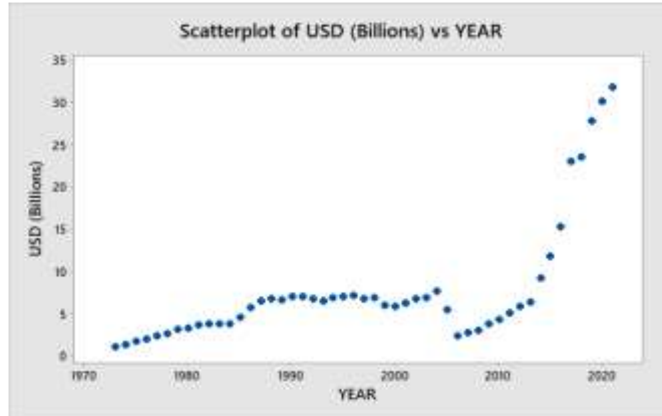

Figure 1: The scatter plot of the time series data against time periods

Source: Output from Minitab version 18

Figure 1 shows that during 1973-1985, 1985 to 1999, and 2000 to 2004, there was a slight increase in government debt, with a minimal growth rate for this period. Figure 1 shows that since 2006, there has been a rapid aggravation of the debt stability of Zambia. The period from January 2006 can be called the extensive growth phase, with a peak value in 2021. This, however, suggests that the foreign debt has been on an upward trend over a long period of time i.e., from 1973 to 1985, 1985 to 1999, 2000 to 2004, and 2006 to 2021. In addition, the graph in Figure 1 is at constant variance because the graph is getting bigger and bigger over time i.e., from 1973 to 1985, 1985 to 1999, 2000 to 2004, and 2006 to 2021 over some time and fluctuating i.e., from 2004 to 2006 over some time.

It should be noted that over the past years, there has been a steady tendency to increase the government debt of Zambia; it is determined by the irrational pursuit of debt policy, high cost of attracting new loans, unstable debt refinancing in previous years, currency risks of the debt, etc.

In order to verify whether the data is stationary time series plot has been plotted, and it is shown in Figure 2.

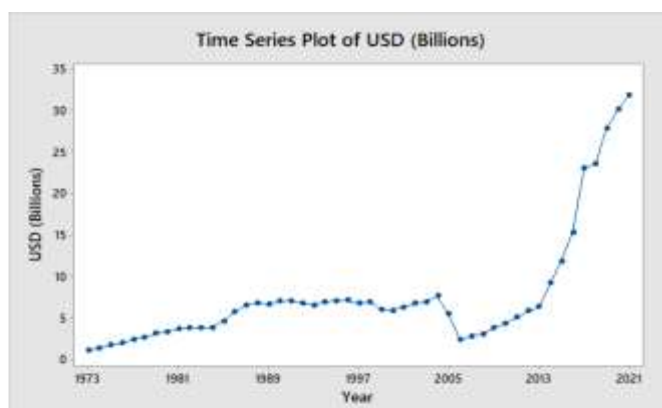

Figure 2: Time series plot of Zambia's Foreign Debt against time

Source: Output from Minitab version 18

It is observed in Figure 2 that the time series data values do not have a constant mean and variances is from 1973 to 2021. Therefore, results also indicate that Zambia's foreign debt has been on an upward trend since 1973 over a long period of time.

To test for stationarity, the unit-root test was applied. Zulu, Mwansa and Wakumelo (2022) stated that the unit-root test it is used to know when to difference time series data to make it stationary. Table 1 shows the unit-root test results for the government debt data series at the level. It shows that the data series is not stationary on the level using test types of Augmented Dickey-Fuller (ADF) and Philips-Perron (PP).

Table 1: Unit-root test results at Level

Series	ADF	PP
Yearly data	0.686103	0.891374
Government debt	(Prob. 0.9958) (-4.356105)* (-3.887219)** (-2.680393)***	(Prob. 0.9958) (-4.356105)* (-3.887219)** (-2.680393)***

Note: *critical value α 1%, **critical value α 5%, *** critical value α 10%

The calculated and critical values of Philips-Perron (PP) t-statistics are the key indicators of the Dickey- Fuller test. Table 2 shows that the calculated value of the t-statistic is 0.9958 and it is greater (lies to the right) than the critical values at the 1%, 5%, and 10% significance levels. Besides, p-value=90% (p-value > 10%) is the minimum probability that a row has a single root and is not stationary. Therefore, the null hypothesis of having a single root in the time series cannot be rejected.

The observed series was transformed to bring it to the stationary process. Since there is an anomalous value in this series (2006) that is not typical for the whole series, it was decided to replace it with an average value (between the previous and the next) to prevent the results from being distorted.

The results of using the Dickey-Fuller test in the first differences indicate the stationarity of the transformed series (Table 3). The value of Philips-Perron (PP)'s calculated τ-statistic (0.0000) is less (lies to the left) than the critical values at 1%, 5%, and 10%; therefore, the null hypothesis on a single root (non-stationarity) in some of the first differences is rejected with a minimum probability of making a 0% mistake (since p-value equals zero).

Table 3: Unit-root test results at Level

Series	ADF	PP
Yearly data	-10.22321	-10.26043
Government debt	(Prob. 0.0000) (-4.356785)* (-3.887567)** (-2.680418)***	(Prob. 0.0000) (-4.356785)* (-3.887567)** (-2.680418)***

Note: *critical value α 1%, **critical value α 5%, *** critical value α 10%

Additionally, consider the graphs of the autocorrelation and partial autocorrelation function of a series of Zambia's government debt (see Figure 4 & 5) to determine the general specification of the future ARIMA model and the number of lags for each component. The correlogram graph is analyzed based on the key properties of the graphs of ACF/PACF functions for MA, AR and ARMA processes (Zulu, Mwansa, & Wakumelo, 2022).

The visual analysis of the correlogram (ACF/PACF functions) makes it possible to determine whether the selected data set is a pure AR or MA process or a mixed ARMA process (Zulu, Mwansa, & Wakumelo, 2022). However, the conclusion on the maximum number of lags can be made only in cases of pure processes.

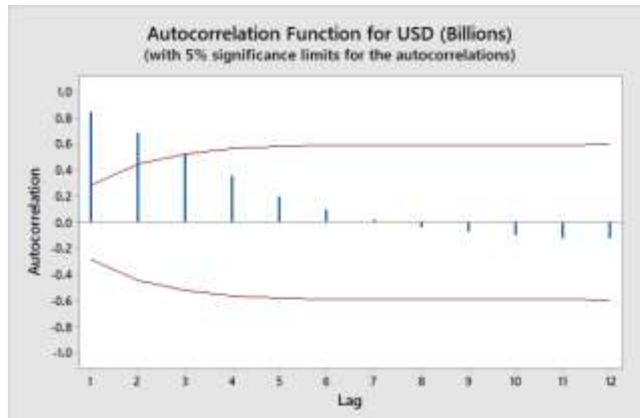

Fig 4: Plot of Autocorrelation against time lag

Source: Output from Minitab version 18

Figure 4 above indicates that the auto-correlations have two statistically significant spikes, indicating that MA (2) behaviour is appropriate for the time-series data. Besides, the coefficient is high at lags 1 and 2, implying a strong or positive correlation between Zambia's foreign debt and the number of years from 1973 to 2021. Also, autocorrelations are declining gradually as the number of lags such property is common in non-stationary processes. Therefore, this suggests that Zambia's foreign debt has been on an upward trend since 1973 over a long period of time.

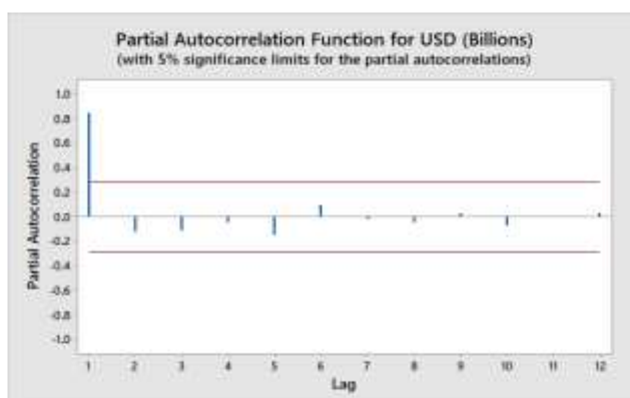

Figure 5: Plot of Partial Autocorrelation Function against time lag

Source: Output from Minitab version 18

At the same time, Figure 5 above reveals that the partial autocorrelations have one statistically significant spike implying that an auto-regressive of order one is appropriate for the time-series data. On the graph, the partial autocorrelations for lag 1 are statistically significant. The subsequent lag is nearly significant. Additionally, on this plot, there is a significant correlation at lag 1 followed by correlations that are not significant. This pattern indicates an autoregressive term of order 1.

As differencing is done one time for converting the non-stationary data into stationary data, it is now possible to define an auto-regressive integrated moving average (ARIMA) model as an appropriate model for studying the given time series data. As the moving average model of order two and the autoregressive model of order one is identified based on the pattern exhibited by ACs and PACs with the first-order differencing, the ARIMA model is defined with reference to the $parameters\ (p, d, q) = (1, 1, 2)$. This model can be represented by

$$Y_t = \beta_0 + \beta_1 Y_{t-1} + \beta_2 Y_{t-2} + \cdots + \beta_p Y_{t-p} + \varepsilon_t$$

or the given time series data, the ARIMA (1, 1, 2) model is fitted using Minitab statistical software (Version 18). The model parameters are estimated as

$\beta_0 - \beta_p = 0.221, \beta_1 = 0.672, \beta_2 = 0.404$ and $\beta_1 = -0.340$. Thus, the fitted series model for Zambia's foreign debt is given by

$$Y_t = 0.221 + 0.672_{t-1} + 0.404_{t-2} - 0.340_{t-q} + \varepsilon_t$$

Stage 2: Model Estimation

The model estimation was carried using Minitab software version 18. The estimates of the model parameters are provided in Table 5, along with their standard errors.

Table 5: Estimation Equation of ARIMA (1, 1, 2)

Type	Coef	SE Coef	T-Value	P-Value
AR 1	0.672	0.191	3.51	0.001
MA 1	0.404	0.209	1.94	0.029
MA 2	-0.340	0.159	-2.15	0.037
Constant	0.221	0.177	1.25	0.217

Source: Output from Minitab version 18

It can be observed from the results that the estimate of the MA1 model is highly significant and that the p-values corresponding to such estimates are all from these observations of times series analysis, it is inferred that the constructed ARIMA model is adequate. The results shown in Table 5 indicate that the ARIMA (1, 1, 2) model performs better than the other models for this given time series. The ARIMA (1, 1, 2) has smaller prediction errors than models like SES or ES, etc. It was rightfully concluded that ARIMA (1, 1, 2) is the best model fit for the Zambia's foreign debt data.

Stage 3: Model Validation and Forecasting

This stage entails validation using out of sample data in order to see whether the suggested model fits the data well and also forecasting the Zambia's foreign debt for some future years and comparing them with the actual years. Both the numerical values and graphical methods are shown for practitioner purposes. Table 6 and Figure 6 below shows

Table 6: Forecasting values for Zambia's foreign debt from 2022 to 2035

Period	Forecast	Lower	Upper
2022	34.3446	32.4341	36.2552
2023	36.8242	34.0661	39.5823
2024	39.3038	35.6469	42.9607
2025	41.7834	37.2065	46.3602
2026	44.2630	38.7556	49.7704
2027	46.7425	40.2986	53.1865
2028	49.2221	41.8379	56.6063
2029	51.7017	43.3748	60.0286
2030	54.1813	44.9099	63.4527
2031	56.6609	46.4439	66.8779
2032	59.1405	47.9769	70.3041
2033	61.6201	49.5092	73.7309
2034	64.0996	51.0409	77.1583
2035	66.5792	52.5722	80.5862

Source: Output from Minitab version 18

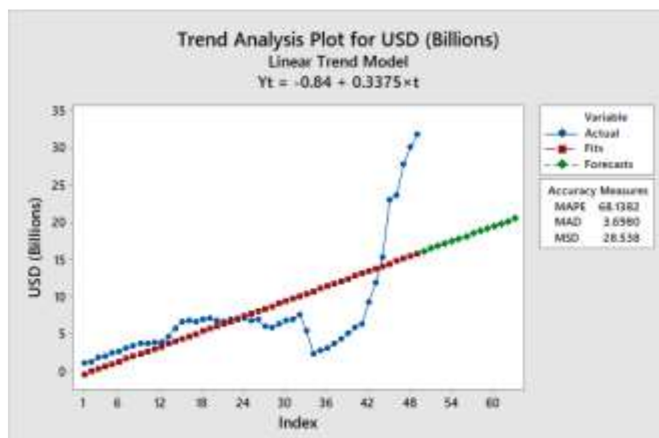

Figure 6: Plot of Forecasting Zambia's foreign debt

Source: Output from Minitab version 18

Results from Table 6 and Figure 6 shows that in 2022, government foreign debt is estimated at USD 36.25 billion, an increase of 14.2% compared to 2021 at USD 31.74 billion. Then, government debt keeps increasing in 2023 at USD 39.58 billion as compared to 2024 at USD 42.96 billion. Thus, this implies that the government debt is estimated to grow by 8.53% from 2023 to 2024.

In 2025, government debt is amounts to USD 46.36 billion and it increases in 2026 at USD 49.77 billion to grow by

7.36%. In 2027, government debt will reach USD 56.19 billion and it keeps growing in 2028 of USD 56.61 billion or 7.71%. In 2029, government debt is predicted to reach USD 60.03 billion and it keeps growing until 2030 at USD 63.45 billion or 7.97%.

In 2031, government debt is amounts to USD 66.88 billion and it increases in 2032 at USD 70.30 billion to grow by 8.22%. In 2033, government debt will reach USD 73.73 billion and it keeps growing in 2034 at USD 77.16 billion or 8.85%. However, in 2035, government debt is amounts to USD 80.59 billion as compared to the year 2034 at USD 77.16 billion or grow by 9.44%. Therefore, the government debt grows by an average of 10.05% in 2035.

Based on forecasting results, Zambia's foreign debt in 2035 is predicted to be USD 80.59 billion and it will keep growing by 10.75% from 2022 until 2035. Compared to the government debt at the beginning of the observation period in 1973 which was amounted to USD 1.03 billion. Then, in 48 years government foreign debt is forecasted to rise by 209.34%. The estimation of Zambia's government foreign debt growth is large and will be very critical if it is not properly controlled and managed to stimulate the economy.

A good financial state is derived from public debt and deduction of interest expense which can cover the difference in tax revenue and expenses productively (Dinca & Dinca, 2015). Cholifihani (2008) states that Zambia faces long-term debt problems because of the improvement of public foreign debt services which can slow economic growth. Also, Bank of Zambia (2021) states that at the end of 2020, the Zambian government debt is prioritized more for the health services sector, social and educational activities, and construction. This is in line with President Hakainde Hichilema's vision which focuses on the development of health, SMEs, education, human resources, and social welfare.

Another factor which is predicted to further increase Zambia's debt in the coming years is the COBID-19 pandemic. COVID-19 pandemic can contribute to the short-run shocks in the Zambia's economy. Then, the Government of Zambia should issue fiscal stimulus policies such as social security, food security, health insurance, pre-employment policies, and tax incentives for the private sectors and also the individuals. Fiscal stimulus policies are not supported by adequate national budgetary capacity, so the most possible way is to issue global bonds with a long-run tenor (Dinca & Dinca, 2015).

IV. CONCLUSION

Zambia is vulnerable to be in the debt trap due to its large debt. This study aimed to dynamically predict the value of government debt over the next fifteen years. In this paper, secondary data from 1973-2021 from Zambia foreign debt statistics published by World Bank are used and analyed by using ARIMA model. The results indicate that the ARIMA model (1,1,2) is the best model fit for the Zambia's foreign debt data. Based on forecasting results, Zambia's government debt will increase significantly amounted to 209.34%from the initial observation period in 1973. In 2035, Zambia's debt is predicted to reach USD 80.59 billion. Having known this, the Government of Zambia should be able to wisely manage its debt to avoid default condition.

The results of this study recommend several policies for the Zambia's government; Funds obtained from foreign debt should be used for productive purposes rather than consumption purposes. Types of productive activities that can can encourage economic growth in Zambia include; agriculture, mining, manufacturing, and tourism, and improving the quality of human resources. Agriculture plays an important role in the Zambian economy, contributing about 20% to the Gross Domestic Product (GDP) and approximately 12% to the national export earnings. Zambia's tourism sector boats of wealth of natural assets such as waterfalls, lakes, rivers and diverse wildlife species. Zambia's tourism industry contributes about 7% of GDP (USD 1,701 million) and 7.2% of total employment (469 thousand jobs), whereas international visitors spend about USD 849 million, representing 10% of Zambia's total export.

Manufacturing plays a key role in helping developing countries facilitate industrialization as well as realize economic growth and development. The contribution of Zambia's manufacturing sector to GDP is about 10.9%. Consequently, mining contributes over 70% of the country's foreign export earnings and also produces 20% of the world's emeralds.

Also, the Zambian government must control the use of foreign debt funds to avoid corruption by applying strict rules and involving the Anti-Corruption Commission of Zambia (ACC).

V. RECOMMENDATIONS

In view of the above findings, the following are some of the measures to be put in place by Zambian government to facilitate growth include:

1. Fiscal discipline and minimize borrowing in the local market so as not crowd out the private sector.
2. Improve regulatory frameworks and remove administrative barriers to business entry and operations and facilitate the development of high growth.
3. Create an enabling macroeconomic environment, strengthen the public agencies that support private sector development and enhance public-private dialogue.

REFERENCE

[1] Al-Shiab, M. (2006). The Predictability of Amman Stock Exchange Performance: A Univariate Autoregressive Integrated Moving Average (ARIMA) Model. European Journal of Economics, Finance and Administrative Sciences, 22(6), 124–39.

[2] Balli, F., & Elsayed, M. E. (2012). Modelling the Currency in Circulation for the State of Qatar." International Journal of Islamic and Middle Eastern Finance and Management 5 (4), 321–39.

[3] Berti, K. (2013). Stochastic government debt projections using the historical variance-covariance 4. matrix approach for EU countries. Economic and Financial Affairs: Economic Paper, 480, 1-26.

Retrieved from https://ec.europa.eu/economy_finance/publications/economic_paper/2013/ecp480_en.htm.

[4] Charles, C., & Shon, J. (2018). The Impact of Public Debt on State Borrowing Cost in the US Bond Market before the Great Recession. Journal of Public Budgeting, Accounting and Financial Management, 30(3), 335–46.

[5] Chatterjee, B., Bhattacharya, S., Taylor, G., & West, B. (2019). Political Competition and Debt: Evidence from New Zealand Local Governments. Accounting Research Journal, 32(3), 344–61.

[6] Chatterjee, B., Bhattacharya, S., Taylor, G., & West, B. (2019). Political Competition and Debt: Evidence from New Zealand Local Governments. Accounting Research Journal, 32(3), 344–61.

[7] Demyanov, R. S. (2017). Ispol- zovaniye metoda Boksa-Dzhenkin-sa dlia prognozirovaniya vremen- nykh riadov [Using the Box-Jenkins method to predict time series]. (In Russian). Retrieved on 15th July 20, 2022 from http:// nauka-rastudent.ru/39/4071/

[8] Dincă, G., & Dincă, M.S. (2015). Public Debt and Economic Growth in the EU Post-Communist Countries.

[9] DiPeitro, W.R., & Anoruo, E. (2012). Government Size, Public Debt and Real Economic Growth: A Panel Analysis. Journal of Economic Studies, 39(4), 410–19.

[10] Fedir, Z., Hanna, F., & John, O.A. (2019). Government debt forecasting based on the Arima model. Public and Municipal Finance, 8(1), 120-127. doi:10.21511/pmf.08(1).2019.11.

[11] Fedir, Z., Hanna, F., Šuleř, P., & Wołowiec, T. (2021). State debt assessment and forecasting: time series analysis. Investment Management and Financial Innovations, 18(1), 65-75. doi:10.21511/imfi.18(1).2021.06.

[12] IMF Staff. (2017). Staff Report on The 2017 Article Iv Consultation— Debt Sustainability Analysis. 22.

[13] IMF Staff. (2005, April 30). IMF Staff Completes 2019 Article IV Visit to Zambia. Retrieved July 22, 2022, from IMF website: https://www.imf.org/en/News/Articles/2019/04/30/pr19130-zambia-imf- staff-completes-2019-article-iv-visit

[14] Iskandar, I., Willett, R., & Xu, S. (2018). The Development of a Government Cash Forecasting Model. Journal of Public Budgeting, Accounting and Financial Management, 30(4), 368–83.

[15] Lukianenko, I. G., & Zhuk, V. M. (2013). Analiz chasovykh riadiv. Pobudova ARIMA, ARCH/ GARCH modelei z vykorystan- niam paketa E.Views [Time series analysis. Construction of ARIMA, ARCH/GARCH models using E.Views package] (187 p.). Kyiv: NaUKMA; Agrar Media Grup. (In Ukrainian). Retrieved March 12, 2022 from http://ekmair.ukma.edu.ua/han- dle/123456789/9085

[16] Mvula, C. (2015). The effects of the structural adjustment programme on the social-economic status of households in urban areas: The case of Chilenje in Lusaka (Thesis). Retrieved January 4, 2022 from http://dspace.unza.zm:8080/xmlui/handle/123456789/3980.

[17] Navapan, K., & Boonyakunakorn, P. (2017). Forecasting the Growth of Total Debt Service Ratio with ARIMA and State Space Model. Predictive Econometrics and Big Data, Studies in Computational Intelligence, 753, 492-501.

[18] Ramzan, M., & Ahmad, E. (2014). External Debt Growth Nexus: Role of Macroeconomic Polices. Economic Modelling, 38, 204–10.

[19] Simumba, T. (n.d.). He Who Pays the Piper: Zambia’s Growing China Debt Crisis.

[20] Stevenson, S. (2007). A Comparison of the Forecasting Ability of ARIMA Models. Journal of Property Investment & Finance, 25(3), 223–40.

[21] Trading Economics. (2019). Zambia-Credit Rating. Retrieved July 22, 2022, from https://tradingeconomics.com/zambia/rating.

[22] World Bank. (2017). Zambia's external debt stocks 1970-2017, public and publicly guaranteed (PPG) (DOD, current US$). Unpublished raw data.

[23] World Bank. (2017). Zambia Concessional debt (% of total external debt). Retrieved from https://data.worldbank.org/indicator/DT.DOD.ALLC.ZS?locations=ZM

[24] World Bank. (2018). Zambia's GDP 1960-2018 (current US$). Unpublished raw data.

[25] World Bank. (2019, March 27). Zambia Overview. Retrieved July 23, 2022, from World Bank website: https://www.worldbank.org/en/country/zambia/overview

[26] Wulf, J. (1988). Zambia under the IMF Regime. African Affairs, 87(349), 579–594. Retrieved from JSTOR.

[27] Žaja, M. M., Kržić, A. S., & Habek, D. (2018). Forecasting Fiscal Variables in Selected European Economies Using Least Absolute Deviation Method. International Journal of Engineering Business Management, 10, 1–19.

[28] Zhuravka, F., Filatova, H., & Aiye- dogbon, J. O. (2019). Government debt forecasting based on the Ari- ma model. Public and Municipal Finance, 8(1), 120-127. https://doi.org/10.21511/pmf.08(1).2019.11.

[29] Zulu, J., Mwansa, G., & Wakumelo, M. (2022). “Forecasting Price of Fuel Using Time Series Autoregressive Integrated Moving Average Model: A Zambian Review From 1998 To 2022”. Ponte International Journal of Sciences and Research, pp.101-118, Vol. 78 | No. 8/1 | Aug 2022,http://www.pontejournal.net/mainpanel/abstract.php?TOKEN=gRkgF5411G&PID=PJ-YQ06M