Revenue Forecasting Using Trend Analysis

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Abstract
Given the inadequacy of the revenue base to cope with the targeted level of economic activities due to the ever-increasing demands of the populace, governments of developing countries (including Ghana) often engage in deficit financing. There is now a consensus among interested parties on the need to address the problem effectively. An appraisal of the budgetary process in Ghana shows that annual expenditure proposals are always anchored on projected revenue, thus the accuracy of revenue projection is a necessary condition for devising an appropriate framework for fiscal deficit management in Ghana.

This study, therefore, analyses the revenue collection of the Customs, Excise and Preventive Service (CEPS) for the period 2008-2012 to devise a reasonably accurate projection for the individual tax components. This will assist in the design of an appropriate expenditure profile as a means of averting any future fiscal deficit in the country.

The data were sourced from the Research and Monitoring Department of CEPS and was analyzed using time series analysis. Overall, the study reports a satisfactory level of revenue performance of the three tax heads; Import Duty, Import VAT and Petroleum Tax. The study concludes that the current revenue profile of CEPS is sustainable with prospect for significant improvement in subsequent years.

The accuracy measures were employed on the various tax inputs and their mean percentage errors, mean absolute deviation and mean squared deviations were compared to decide on which method will be the pest model for revenue projection. As regard to the results obtained the growth curve model will be the preferred method in forecasting revenues in the Customs Excise and Preventive Service in Ghana.

Keywords: import duty, import vat, petroleum tax national health insurance levy (NHIL)

1. Introduction
Understanding revenue forecast practices is essential in assessing budget planning and management process. Revenue forecast define the budget envelope and form the basis for effective term planning. This serves as the principal resource constraint and, if integrated in a top-down budget preparation process approach, facilitates allocation of expenditures across different uses.

Furthermore, transparency of forecasting process is key in creating accountability in the revenue collection process, as manipulation of forecast can conceal governance problems. (Danninger et. al, 2004)

Forecasting future tax revenue is difficult, yet governments have no choice but to do so. State official base their one- to two year budgets on an estimate of how much money is available to spend, and that includes estimates about how much tax money they expect to see from income sales and cooperate tax. (Pattison, 2014)

On December 31, 2009 an assent was given to the Ghana Revenue Authority Act, 2009 (Act 791). The Act was passed to establish the Ghana Revenue Authority to replace the Value Added Tax Service, Internal Revenue Service and Custom, Excise and Preventive Service for the administration of taxes and to provide for related purposes in the country. Under this Act, Custom, Excise and Preventive Service has been called Customs Division whiles the Value Added Tax and Internal Revenue Service have been combined to become Domestic Tax Revenue Division of the Ghana Revenue Authority (Ghana Revenue Authority act, 2009, Act 791).

The Customs, Excise and Preventive Service (CEPS) is a state organization responsible for the collection of Import Duties, Import VAT, Petroleum Tax and other taxes from ports , harbours and approved points of entry to Ghana. CEPS collects about 50% to 60% of the total government domestic revenue which is used to finance Ghana's recurrent budget and for development projects in the health, education, housing, transport sector etc.

The revenues of Ghana Government are generated largely from direct taxes, taxes on international trade, indirect taxes and other taxes which are collected by the VAT Service, the Internal Revenue Service and the Customs, Excise and Preventive Service. National budget revenues are therefore strongly tied to the growth of income and spending within the nation.   Reliable and trusted revenue predictions provide the foundation for fiscal discipline and for the adoption of an executable public budget. For example, the total revenue for the 2006 budget was projected at 38.97 trillion Ghana Cedis, with domestic revenue projected at 26.42 trillion Ghana Cedis (a 10% increase over the expected revenue for 2005). Tax revenues from the three (3) revenue collecting agencies were projected at 24.19 trillion Ghana Cedis (equivalence of about 22 percent of the GDP). There is an interesting literature base with regard to forecasting techniques of government agencies and a number of informative articles on fiscal stress in governments. After reviewing available literature, one question arose.   That is, how do government agencies forecast revenue?

Accurate revenue forecast are important because they form the guidelines for budget development and set the tone for the budget process. According to Agostini, (1991), in public-sector budgeting, the availability of resources circumscribes discussions about expenditures. As these discussions intensify in the face of mounting fiscal duress, reliable and informative revenue forecasts becomes critical elements of the budgetary process. However, government agencies rarely methodically forecast revenues for longer time periods than the next budget year. (Wong, 1995).

Forecasting beyond one year can be very useful in identifying the direction and significance of financial and economic trends. This can also assist budget and finance officers, as well as senior management to anticipate future challenges and develop long-term plan.

Another important characteristic of a sound revenue forecasting system is that it forces budget and finance officers to identify assumptions related to future economic issues.   It forces them to be more aware of economic conditions and relational impacts that could occur from national events.

According to Ascher (1978), the assumptions employed are more important determinants of reliability of the forecast, than are the specific techniques employed to produce the forecast.

Time series forecasting models such as moving averages, exponential smoothing and Box-Jenkins have not been extensively used in government agencies (Bretschneider and Gorr, 1987).   However, empirical evidence indicates that these types of techniques can substantially improve accuracy in identifying the annually budgeted resource constraints and in updating current year forecast (Frank and Gianakis, 1990).

The limited use of these techniques has been linked to several derivative factors. Much of research shows that many budget and finance officers are not adequately exposed to these techniques in either their formal education or professional training (McCullough and Frank 1992). Any exposure they did have, was not sufficient for the officers to take the techniques to their own organization and apply them on a daily basis. Finance officers may also be reluctant to implement the new techniques due to an aversion to risk when it comes to experimenting with new methodologies (Frank and Gianakis, 1990).

In addition, many government agencies may have little incentive to improve forecast accuracy if they have not experienced adverse consequences due to inaccurate forecasts.

Wildavsky (1986) noted that politicians generally accept revenue forecasts with little questioning or detail. Therefore, if there is no pressure to improve, many finance officers will continue with 'business as usual' and not take on the risk of introducing new and innovative techniques or strategies.

Budget and Finance officers also tend to have a conservative bias because they typically under forecast their entities' revenue.   This is mainly due to the requirement that they maintain a balance budget (Bretschneider and Schroeder, 1988). Their preference towards judgmental approaches to forecasting may be a reflection of this basis. Rubin (1987) also suggests that decision makers may encourage under-forecasting in order to make discretionary funds available during the fiscal year that can be reallocated outside of the regular budget process. Although many reasons can be sighted explaining why budget officers desire to use mainly judgmental forecasting techniques, empirical evidence continues to support that forecasting accuracy can be significantly improved with the use of a systematic approach.

Armah (2003) contend that despite the all too often celebrations by revenue collecting agencies that they have achieved their revenue targets, questions are being asked whether the revenue targets appropriately reflect the nation's macro-economic framework. He described as flawed the revenue setting mechanism because the forecasting mechanism is poor. While very limited research has been conducted with regards to revenue forecasting and its impact on national economy, there has been no research conducted related to the forecasting strategies adopted by the Customs, Excise and Preventive Service. This study attempts to evaluate better a revenue forecasting techniques for CEPS.

1.1 Objectives

    i.   Determine a suitable trend pattern of revenue collection for the period.

    ii.   To fit a suitable model to the quarterly revenue data and

    iii.   Forecast the future revenue expected for the next five years.

1.2 Data

The Research and Monitoring Department of CEPS is responsible for revenue data gathering and revenue planning in relation to revenue targets set for the service by the Ministry of Finance. The data was therefore obtained from the Research and Monitoring Unit of CEPS. It covers the year 2008 to 2012 revenue collections of Import Duties, Import VAT, NHIL and Petroleum Tax. The data consist of collection of revenues collected every month from Tema, Takoradi, KIA, Aflao, Accra, Kumasi, Koforidua, Ho, Sunyani, Tamale, Elubo, Bolgatanga and Wa, which are the main collection points in Ghana.

The data was grouped into quarters for the analysis. This was necessary because the CEPS performances are measured quarterly. Thus for the seven year period we have twenty eight quarters o revenue performances.

In general the performance for the import duty increased quarter by quarter after quarter, like wise the import vat and NHIL. However there was a slight decrease in petroleum tax from the eleventh quarter to the twenty- first quarter. Thus the third quarter of 2007 to the first quarter of 2011. Despite the decrease in in the petroleum tax during that period the general increase in the total revenue was not affected.

2. Methodology

A time series is a set of observation on variable of interest that has been collected in time order. The value of the time deposits are observed at equally spaced time points (quarterly) (Bowerman, L. B and Connel R. T).

A univariate time series model is used to predict future values of time series sorely on the basis of past values of time series. When such model is used, historical data is analysed in order to identify a pattern .then assuming that it will continue in the future, this data pattern is extrapolated to produce a forecast.

Trend models in time series is applied in this research. There are four different models one can choose from, linear (default), quadratic, exponential growth curve, or s-curve (Pearl-Reed logistic.

Linear Trend Analysis

Trend analysis by default uses the linear trend model; $Y_t = \beta_0 + \beta_1 t + \varepsilon_t$. In this model, β_1 represent the average change from one period to the next.

Quadratic trend Model

The quadratic trend model, which can explain simple curvature in the data is $Y_t = \beta_0 + \beta_1 t + \beta_2 t + \varepsilon_t$

Exponential Growth Model

The exponential growth trend model explains exponential or decay. For example, a saving account might exhibit exponential growth. The model is $Y_t = \beta_0 + \beta_1^t + \varepsilon_t$

S- curve trend model

the S-curve trend model fits the Pearl-Reed logistic trend model. This explains the cases when series follow an S-curve. The model is $Y_t = 10^a \Big/ \beta_0 + \beta_1 \beta_2^t$.

To chose between these four models we examine a representation of the time series (time series plot) if the representation looks linear, we use the linear trend model, if it exhibits some curvature or exponential trend, we examine the quadratic or exponential model. If it has S-shape we choose S-curve model.

We can also fit all four models and compare the mean accuracy MAPE, MAD and MSD and choose the model with the smallest accuracy measure.

Mean absolute percentage error (MAPE); this expresses accuracy as a percentage of the error. Because this number is a percentage, it can be easier to understand than the other statistic. For example if the MAPE is 5, on the average the forecast is off by 5%.

Mean absolute deviation (MAD) expresses accuracy in the same units as the data which helps conceptualize the amount of error. Outliers have less effect on MAD than MSD.

Mean Squared Deviation (MSD) is a commonly used measure of fitted time series values. Outliers have a greater effect on MSD than MAD.

3. Analysis of Results

Table 1: Accuracy Measures for Import Tax

	LINEAR TREND MODEL	QUADRATIC TREND MODEL	GROWTH CURVE MODEL
MAPE	18.04	10.82	8.45
MAD	32.52	18.40	17.70
MSD	1890.11	471.52	456.42

The results in Table 1 above reveals the accuracy measures for the import tax under the three models chosen. Comparing all the three models it can be seen that the exponential growth model has the least values of 8.45, 17.70 and 456.42 for MAPE, MAD, and MSD respectively. The corresponding trend models are $Y_t = 18.48 + 15.91_t$, $Y_t = 112.20 - 2.84t + 0.65t^2$ and $Y_t = 82.17 \times (1.07)^t + \varepsilon_t$.

Table 2: Accuracy Measures for Import Vat

	LINEAR TREND MODEL	QUADRATIC TREND MODEL	GROWTH CURVE MODEL
MAPE	14.24	7.77	6.24
MAD	28.37	14.73	13.35
MSD	1190.10	391.38	349.86

Similarly the accuracy measures in Table 2 also reveal that the growth curve model has the least values with 6.24, 13.35 and 349.86 for MAPE, MAD, and MSD. The trend models Linear, Quadratic and Growth Curve were $Y_t = 32.44 + 14.01_t$, $Y_t = 102.50 - 0.06t + 0.49t^2$ and $Y_t = 84.17 \times (1.07)^t$ respectively.

Table 3: Accuracy Measures for NHIL

	LINEAR TREND MODEL	QUADRATICTREND MODEL	GROWTH CURVE MODEL
MAPE	14.11	7.86	6.42
MAD	5.65	2.97	2.72
MSD	47.89	15.78	14.16

The MAPE, MAD, and MSD's for NHIL growth accuracy curve models were the least accuracy measure, having 6.42, 2.72, and 14.16 and the trend models are linear trend, quadratic trend a nd growth curve models were $Y(t) = 6.59 + 2.80(t)$, $Y(t) = 20.59 - 0.004t + 0.10t^2$ and $Y(t) = 16.96 \times (1.06)^t + \varepsilon_t$ respectively.

Table 4: Accuracy Measures for Petroleum Tax

	LINEAR TREND MODEL	QUADRATICTREND MODEL	GROWTH CURVE MODEL
MAPE	21.90	15.89	21.96
MAD	18.69	14.13	19.45
MSD	518.4	266.96	528.29

In table 4, the quadratic trend model has the least accuracy measure, thus having 15.89, 14.13 and 226.96 for the MAPE, MAD and MSD respectively. The trend models were also $Y(t) = 94.42 + 0.29(t)$, $Y(t) = 133.90 - 7.61t + 0.27t^2$ and $Y(t) = 93.99 \times (1.00)^t + \varepsilon_t$ for linear, quadratic and growth curve models respectively.

Table 5: Accuracy Measures for Total Revenue

	LINEAR TREND MODEL	QUADRATICTREND MODEL	GROWTH CURVE MODEL
MAPE	15.5	9.11	8.25
MAD	87.4	45.91	53.76
MSD	1104.1	3175.68	4984.73

Table 5 presents the accuracy measures of the total revenue, and the least accuracy measure was between the quadratic trend model and the growth curve model. Whiles the MAPE, MAD and MSD's of the quadratic curve model were 9.11, 45.91 and 3175.68 respectively, that of the growth curve model were 8.25, 53.56 and 4984.75. Also the corresponding trend models for the were $Y(t) = 153.82 + 32.93(t)$,

$Y(t) = 374.60 - 11.23t + 1.52t^2$ and $Y(t) = 273.37 \times (1.05)^t + \varepsilon_t$ for linear, quadratic and growth curve models respectively

Conclusion
The results obtained from Tables 1 suggest that the growth curve model is the best model to forecast the import tax, thus, it is the method which yields the smallest MAPE, MAD and MSE values. In the same way the growth curve model is preferred method in predicting future revenues for import vat since it also has the smallest MAPE, MAD and MSE values as it can be seen in Table 2
Similarly in Table 3 MAPE, MAD and MSE value of NHIL indicates that the growth curve model is the preferred method; however from Table 4 the smallest MAPE, MAD and MSE values of the petroleum tax is achieved when the quadratic trend model is applied.

From Table 5 it can also be seen that the decision is on both the quadratic trend model and the growth curve model since the they all have the smallest accuracy ratio as compared to the linear trend model, but since the ratio of the growth curve model to the quadratic tend model as regard to the five tables is 3:1, the growth curve model will be the preferred method to use in forecasting the revenues in CEPS.

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