**Forecast approach**

**Data:**

We used yearly data from 2000 to 2020 for current revenue data for the series of total revenues and grants, recurrent revenue, tax revenue, income and profits, taxes on goods and services, non-tax revenue, licenses, royalties, government ministries and repayment of old loans. On the expenditure side we have current prices data from 2001 to 2021 on the series of total expenditure, total recurrent expenditure, personal emoluments, pensions and ex gratia, goods and services, and debt service interest.

As the expenditure in goods and services series started including the subsidies and transfers data from 2012 on, we opted to sum these series values as to only account for one series of goods and services which now includes both goods and services and subsidies and current transfers. Data for revenue was obtained from the executed fiscal data of Belize while for expenditures we used budgeted fiscal data.

Regarding quarterly data, we have 90 observations from the first quarter of 2000 to the second quarter of 2022 on current revenue, total revenue and grants, current expenditure, and total expenditure. All series are on constant prices with base the first quarter of 2000, including GDp.

**Methodology:**

The methodological approach was that of VAR and VEC models forecasting, which means that the forecast was performed using more than one series. In this case each forecast was performed with a pair composed of one of the available series with the corresponding Belize yearly GDP.

First, we transform each pair of series to logarithms and evaluate for unitary root presence via the Augmented Dickey-Fuller test in order to identify the integration order of the series. Once the integration order of the series has been determined, we select the optimal approach based on two possible scenarios.

1. **Both series are I(0) (No unitary root):** If this is the case we perform a 4-step ahead forecast for expenditures and a 5-step ahead forecast of revenues based on a VAR model in levels, given that the series are stationary and therefore there is no way to account for possible cointegration. The model used is:

where is a vector of endogenous variables and assigns a spherical disturbance term of the same dimension. The coefficient matrices are of dimension

The inclusion of deterministic trends such as constant or trend is assessed via the minimization of the AIC for each of the possible models.

1. **Both series are I(1) (Unitary root):** Now, as both series are non-stationary, we can check for cointegration between the series, for this we used the Johansen approach through the maximum eigen value test, which provides two possible outcomes.
   1. **Cointegration:** If given the test results we find the respective matrix has reduced rank, we are able to estimate a VECM(p-1) model to perform a 4-step ahead forecast for expenditures and a 5-step ahead forecast of revenues with it’s VAR representation. The model used is:

Where the rank of the matrix determines if there is presence of cointegration if it is of reduced rank (K > rank > 0).

* 1. **No cointegration:** If given the test results we find that the respective matrix has rank 0, we use a VAR(p) model in first differences to perform a 4-step ahead forecast for expenditures and a 5-step ahead forecast of revenues. In this case, the series are differenced, and the first model presented is estimated.

For any given model, the optimal lags are chosen via minimization of the Akaike Information Criteria (AIC) accounting for a maximum of two (2) lags for yearly data given the limited sample (20 observations). Lastly, all tests are evaluated at the 95% confidence level.

**Results:**

Given the lack of yearly data, and that the last year available matches the first year of the COVID-19 pandemic, forecasts have a tendency to go down. To solve this issue, we opted instead to annualize the quarterly forecasts to obtain yearly information based on more available quarterly data.

**Forecast Results**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Year** | **Revenue Current** | **Total Revenue and Grants** | **Expenditure Current** | **Total Expenditure** |
| 2000 | 349.794 | 415.968 | 308.365 | 541.718 |
| 2001 | 372.053 | 458.645 | 333.665 | 589.166 |
| 2002 | 425.757 | 478.927 | 333.443 | 593.752 |
| 2003 | 421.822 | 453.036 | 421.822 | 627.470 |
| 2004 | 461.993 | 519.170 | 467.684 | 647.313 |
| 2005 | 511.470 | 531.940 | 561.151 | 684.239 |
| 2006 | 565.949 | 601.217 | 550.833 | 648.578 |
| 2007 | 651.465 | 765.666 | 636.119 | 796.505 |
| 2008 | 732.344 | 803.642 | 617.859 | 759.462 |
| 2009 | 660.274 | 699.021 | 662.066 | 775.396 |
| 2010 | 753.768 | 769.522 | 682.734 | 815.864 |
| 2011 | 786.986 | 816.184 | 717.380 | 839.094 |
| 2012 | 825.602 | 877.608 | 740.840 | 902.740 |
| 2013 | 851.580 | 884.941 | 743.623 | 922.113 |
| 2014 | 911.668 | 1000.364 | 817.570 | 1099.118 |
| 2015 | 993.985 | 1022.291 | 893.990 | 1298.593 |
| 2016 | 1002.577 | 1039.419 | 950.942 | 1158.487 |
| 2017 | 1047.930 | 1074.233 | 1005.828 | 1177.596 |
| 2018 | 1139.369 | 1193.703 | 1052.851 | 1221.276 |
| 2019 | 1147.700 | 1176.344 | 1084.504 | 1306.670 |
| 2020 | 944.221 | 986.585 | 1007.379 | 1352.513 |
| 2021 | 1081.920 | 1100.555 | 933.914 | 1168.061 |
| 2022 | 1215.577 | 1224.741 | 948.266 | 1216.604 |
| 2023 | 1270.362 | 1289.565 | 986.589 | 1259.786 |
| 2024 | 1343.156 | 1356.604 | 1032.582 | 1306.458 |
| 2025 | 1421.152 | 1426.762 | 1083.242 | 1358.856 |

The following table contains the annualized quarterly forecasts for revenue current, total revenue and grants, expenditure current and total expenditures. Note that the blue areas are the forecasts and for the year 2022 only the last two quarters are forecasted.