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The Holt-Winters method to estimate currency in circulation in Mozambique

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Currency in circulation is the most liquid monetary aggregate and represents the outstanding amount cash circulated in the economy. The impact of cash on carrying out transactions makes this aggregate a key element, requiring monetary authorities to make more accurate models to guarantee supply of cash to the economy in sufficient quantities and in a timely manner. Analysis carried out suggested that currency in circulation in Mozambique has an increasing trend and is seasonal, these patterns led us to consider the multiplicative Holt-Winters method as suitable for its estimation, which, in fact provided a satisfactory result.

Keywords: Box-Cox transformation, currency in circulation, non stationary, seasonality

Currency in circulation represents banknotes and coins placed into the economy by the central bank to respond to the demand for cash, especially for carrying out day-to-day transactions [1, 4]. Monthly data, in millions, collected from January 2005 to December 2022, from the database of the Bank of Mozambique, shows that the currency in circulation in Mozambique has an increasing trend and oscillatory movements, indicating the presence of seasonality. Therefore, the series is not stationary in mean and variance.

When it comes to its decomposition into four components, namely, the trend (T_t), cycle (C_t), seasonality (S_t) and randomness (ϵ_t), there is an increasing linear trend and seasonal patterns which increases over time, so, the currency in circulation in Mozambique can be represented in the following multiplicative form: $CiC_t = T_t * C_t * S_t * \epsilon_t$ (where CiC_t represents currency in circulation in Mozambique).

Accordingly, considering the sample of 204 observations, the estimates for the level and slope for the last observed period are: $a_{204} = 11.11$ and $b_{204} = 0.01$, respectively, and the smoothing constants are: $\alpha = 0.80$, $\beta = 0.02$ and $\gamma = 0.87$. These findings suggest that CiC_t can be estimated using a Holt Winters model, which is suitable for estimating series with a linear trend and increasing or decreasing seasonal movements [2, 3].

As the currency in circulation is not stationary, analyzes carried out, allowed us to conclude that the Box-Cox transformation with the best results in stabilizing the variance of the series is a logarithmization. Therefore, the series was transformed into $\ln(C_i C_t)$. Then, a non-seasonal differentiation and a seasonal differentiation were applied to eliminate the trend and seasonality, which resulted into a stationary series that allowed us to continue modeling.

Regarding the diagnosis, after estimating the model parameters, we verified that the residuals have an approximately normal distribution and, also, we did not reject the null hypothesis of the absence of autocorrelations. Once the assumptions have been verified this reveals that the residuals are “well behaved”, which allows us to conclude that the Holt-Winters multiplicative method can be considered as a possible “method” to model currency in circulation in Mozambique.

References

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