Crunching the Numbers: A Comparison of Econometric Models for GDP Forecasting in Madagascar

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Abstract

In this study, we evaluate the effectiveness of three popular econometric models ARIMA, MIDAS, and VAR for forecasting quarterly GDP in Madagascar. Our analysis reveals that ARIMA provides the most accurate forecasts among the three models, indicating its superiority in predicting the country's economic performance. However, we also argue that combining multiple models can offer additional benefits for forecasting accuracy and robustness. By leveraging the strengths of each model, such an approach can provide more reliable forecasts and reduce the risk of errors and biases associated with using a single model. Our findings have important implications for policymakers, economists, and investors who rely on GDP forecasts to make informed decisions about economic policies and investments in Madagascar.

KEYWORDS: GDP, Madagascar, Quarterly data, Forecasting, Arima, Var, Midas.

1 Introduction

Econometric models are widely used in forecasting various economic variables, including GDP. In Madagascar, accurate GDP forecasts are particularly crucial for policymakers and stakeholders who need to make informed decisions about economic development and resource allocation.

In this study, we focus on three widely used econometric models (ARIMA, VAR, and MIDAS) and compare their forecasting performance for Madagascar's GDP. We aim to identify the most effective model in terms of forecasting accuracy and highlight the potential benefits of using each model.

2 Literature Review

Time series analysis is a widely used technique in econometric modeling for forecasting and understanding the dynamics of economic variables. The works of Box and al. (1976),Harvey (1993), Hamilton (2009), and Tsay (2010) are some of the seminal contributions in this field.

Box and al. (1976)' book introduced the ARIMA (Autoregressive Integrated Moving Average) model, which is widely used to analyze and forecast time series data. Harvey's book *Time Series Models* provides an excellent introduction to the subject, covering topics such as stationarity, autoregressive and moving average models, and multivariate time series analysis.
The literature also presents alternative methods to the ARIMA model. One such method is the use of vector autoregression (VAR) models, which allow for the estimation

of relationships between multiple variables simultaneously Enders (2010) Lutkepoh (2005) Stock and al. (2007) . Another method is the use of mixed data sampling (MIDAS) regression models, which combine high-frequency and low-frequency data to improve the accuracy of forecasts Ghysels and al. (2002).

In terms of empirical studies, Maddala (2009) provides an overview of the various methods used in econometric modeling, including time series analysis. Additionally,Gujarati and al. (2009) provides an introduction to the topic and covers important concepts such as trend, seasonality, and cyclical behavior.

In the case of Madagascar, the National Institute of Statistics INSTAT (2022) provides quarterly data on various macroeconomic variables, including GDP. This data can be used to develop econometric models to forecast GDP. However, to the best of our knowledge, there is no published research specifically comparing the performance of different time series models for forecasting GDP in Madagascar.

Overall, the literature suggests that ARIMA, VAR, and MIDAS models are all effective methods for forecasting time series data. The choice of which method to use depends on the characteristics of the data and the research question at hand. In the context of Madagascar, further research is needed to determine which method provides the most accurate forecasts of GDP.

In conclusion, time series analysis is a fundamental tool for econometric modeling and forecasting. The works of Box and al. (1976) ,Harvey (1993), Hamilton (2009), and Tsay (2010) have provided important contributions to the field, and alternative methods such as VAR and MIDAS models have also been developed. The use of these methods to forecast GDP in Madagascar has not been extensively studied, highlighting the need for further research in this area.

3 Methodology

This study employs econometric models to forecast GDP in Madagascar using quarterly data from INSTAT. Specifically, three models are compared: ARIMA, VAR, and MIDAS.

3.1 Data Collection

The data used in this study was collected from the National Institute of Statistics in Madagascar (INSTAT). The dataset consists of quarterly GDP values for the period from 2010 to 2021.

3.2 Models

3.2.1 ARIMA Model

ARIMA (Autoregressive Integrated Moving Average) models are widely used in time series analysis to forecast future values based on past observations. The ARIMA model consists of three components: the autoregressive (AR) component, the integrated (I) component, and the moving average (MA) component. The AR component captures the influence of past values on the current value, while the MA component captures the influence of past errors on the current value. The I component represents the differencing required to make the time series stationary. A stationary time series has a constant mean and variance over time, and is easier to model and forecast than a non-stationary time series. The order of the ARIMA model is determined by the number of AR, I, and MA terms required to make the time series stationary.

In this study, the ARIMA model was used to forecast GDP in Madagascar. The model was estimated using the Box-Jenkins method, which involves identifying the appropriate orders of the AR, I, and MA components based on the autocorrelation and partial autocorrelation functions of the time series data. The model was then used to forecast

GDP values for the next four quarters (Q3 2021 to Q2 2022).

3.2.2 VAR Model

Vector Autoregression (VAR) models are a type of time series model that allows for the estimation of the relationships between multiple variables simultaneously. The VAR model consists of a system of equations, with each equation representing one variable in the system. Each equation is a function of the lagged values of all the variables in the system. The VAR model is estimated using the least squares method, and the lag order is determined using information criteria such as Akaike Information Criterion (AIC) or Bayesian Information Criterion (BIC).

In this study, a VAR model was used to forecast GDP in Madagascar. The VAR model included two variables: GDP and the inflation rate. The model was estimated using quarterly data from Q1 2010 to Q2 2021, and was used to forecast GDP values for the next four quarters.

3.2.3 MIDAS Model

Mixed Data Sampling (MIDAS) regression models are a type of time series model that combines high-frequency and low-frequency data to improve the accuracy of forecasts. In the context of GDP forecasting, the high-frequency data typically represents monthly or quarterly data on a related variable, while the low-frequency data represents annual or quarterly GDP data. The MIDAS model consists of a system of equations, with each equation representing one variable in the system. The high-frequency data is included in the model as an independent variable, and the low-frequency data is included as the dependent variable. The model is estimated using the least squares method, and the lag order is determined using information criteria such as AIC or BIC.

In this study, a MIDAS model was used to forecast GDP in Madagascar. The model included quarterly data on the inflation rate as the high-frequency data, and quarterly GDP data as the low-frequency data. The model was estimated using data from Q1 2010 to Q2 2021, and was used to forecast GDP values for the next four quarters.

3.3 Models evaluation

To evaluate the performance of each model, the Mean Absolute Error (MAE), Mean Absolute Percentage Error (MAPE), and Root Mean Squared Error (RMSE) are calculated for each model. The MAE and RMSE measures the average magnitude of the errors between the predicted and actual GDP values, while the MAPE measures the percentage error between the predicted and actual GDP values.

The model with the lowest MAE, MAPE, and RMSE is considered the best performing model for forecasting GDP in Madagascar

4 Results

Table 1 presents the evaluation results for the three econometric models. Overall, the ARIMA model has the lowest values for all three evaluation metrics, indicating its superior forecasting accuracy.

The MAE for the ARIMA model is 49.79, compared to 72.26 and 67.70 for the VAR and MIDAS models, respectively. The MAPE and RMSE also show that the ARIMA model outperforms the other two models. However, it is worth noting that the VAR and MIDAS models also demonstrate competitive performance, particularly in capturing the dynamics of the data.

Table 1 Results for the three models

Model	MAE	MAPE	RMSE
ARIMA	49.79	4.38	58.03
VAR	72.26	6.47	87.63
MIDAS	67.70	5.96	83.68

5 Conclusion

In conclusion, our analysis has shown that the ARIMA model performs better for forecasting GDP compared to other individual models. However, it is important to note that using a single model may not always provide the most accurate forecast, and employing multiple models may yield better results. By utilizing multiple models and combining their forecasts, we can reduce the uncertainty and improve the accuracy of our GDP forecasts. Therefore, a combination of ARIMA model and other appropriate models could be an effective approach to forecast GDP in practice.

However, it is important to note that our study has some limitations. First, we only considered three econometric models in our analysis, and there may be other models that could perform better. Second, our study only used quarterly data, and higher frequency data may provide more accurate forecasts. Finally, our study only examined the forecasting accuracy of the models and did not consider the economic interpretability of the models.

Despite these limitations, our study provides useful insights into the relative performance of different econometric models in forecasting GDP in Madagascar. Future research could consider other models and higher frequency data to provide more accurate and robust forecasts of Madagascar's GDP.

References

Box, G. E. P., & Jenkins, G. M. (1976). *Time series analysis: forecasting and control*. Holden-Day.

Enders, W. (2010). *Applied econometric time series*. Wiley.

Ghysels, E., Santa-Clara, P., & Valkanov, R. (2002). The MIDAS touch: Mixed data sampling regression models. *National Bureau of Economic Research*.

Gujarati, D. N., & Porter, D. C. (2009). *Basic econometrics*. McGraw Hill.

Hamilton, J. D. (1994). *Time series analysis*. Princeton University Press.

Harvey, A. C. (1993). *Time series models*. MIT Press.

Instat Madagascar. (2022). *Quarterly National Accounts*. Retrieved from https://www.instat.mg/publication/trimestrielles/

Lütkepohl, H. (2005). *New introduction to multiple time series analysis*. Springer.

Maddala, G. S., & Lahiri, K. (2009). *Introduction to econometrics* (4th ed.). Wiley.

Stock, J. H., & Watson, M. W. (2007). *Introduction to econometrics* (2nd ed.). Pearson.

Tsay, R. S. (2010). *Analysis of financial time series* (3rd ed.). Wiley.

Wei, W. W. S. (2006). *Time series analysis: Univariate and multivariate methods* (2nd ed.). Pearson.