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Introduction

This is a time series forecast and prediction on the Federal Reserve Economic Data (FRED) on whether an economic contraction will occur at Quarter 1, 2 and 4 in 2025. The data set chosen was FRED-QD: Quarterly Data as Monthly Data was more prone to fluctuations which was not ideal. Our time range was narrowed down from 2006 to 2024 after omitting missing values. This is suitable given that the 21st century reflects today's modern economic environment and both the 2008 Financial Crisis and the COVID-19 pandemic in 2020 would be taken into consideration.

Figures 1 and 2 show the trends in GDP and GDP growth from 2006 to 2024.

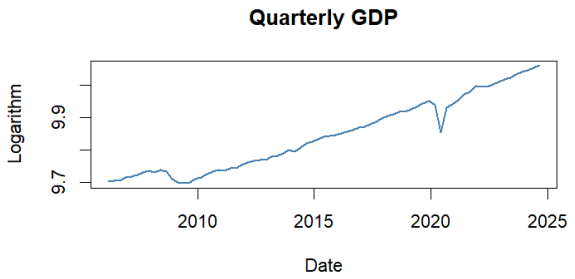

Fig. 1: Quarterly GDP (Billions of 2017 Dollars) from 2006 to 2024

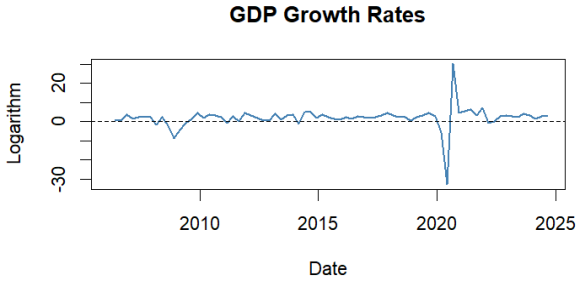

Fig. 2: GDP Growth Rates from 2006 to 2024

Methodology

As the data was originally categorised into 14 groups, we explored the correlation between predictors and outcome variable, GDPC1. Figures 3.1 - 3.6 show the groups which are more influential in determining GDP. These groups have strong correlation to GDP as a whole, with the exception of group 8 (Interest rates) where the strongest correlation was around |0.5|.

Due to the large number of predictors, the 246 predictors were categorised into 14 thematic groups (FRED-QD Appendix) and Principal Component Analysis (PCA) was implemented for dimension reduction and data scaling in each group of variables, except in Group 12, titled 'Other'. Correlation plots of selected groups are shown below. In the first round of PCA, principal components that surpassed the 0.9 threshold of variance explained were chosen and PCA was then conducted once again on the chosen principal components across all the groups, including

Group 12. The results from this PCA allowed us to reduce the number of principal components to 7. We then used these 7 principal components to fit an Autoregressive Distributed Lag (ADL) Model.

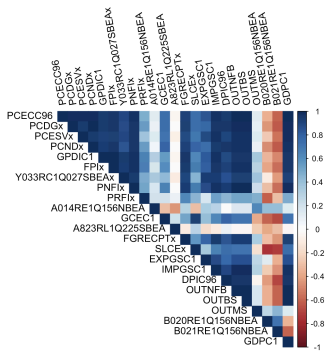

Fig 3.1: Correlation Plot for Group 1

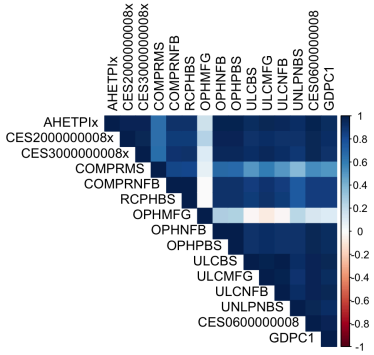

Fig 3.2: Correlation Plot for Group 7

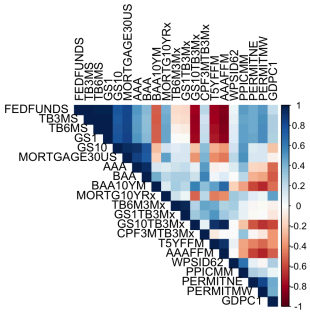

Fig 3.3: Correlation Plot for Group 8

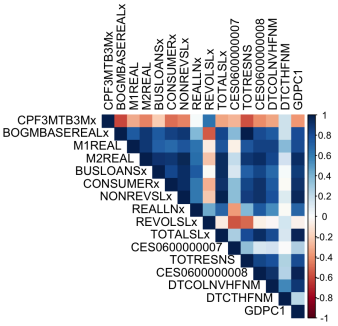

Fig 3.4: Correlation Plot for Group 9

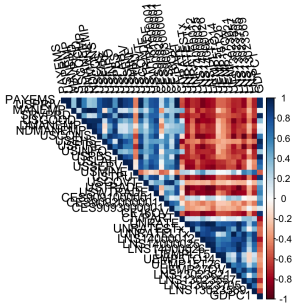

Fig 3.5: Correlation Plot for Group 3

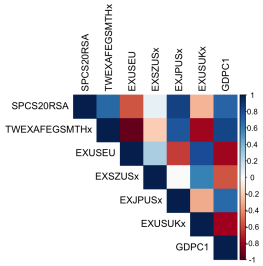

Fig 3.6: Correlation Plot for Group 11

Model

We first built two models AR(1) and AR(2) to determine whether the lag of GDP has to be added into our final model. Akaike Information Criterion (AIC) was used to determine the optimal lag length. Ultimately, AR(2) produced a smaller AIC (11.3<15.4) and the lag order of GDP was

determined to be 2. Root mean squared forecast error of AR(2) was computed to be 27.5. A fan chart, fitted with a seasonal ARIMA model was plotted to show the GDP forecast in Figure 4.

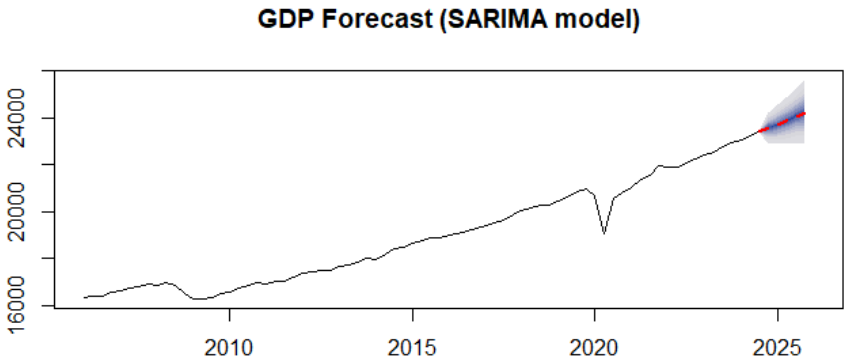

Fig. 4: Fan chart of GDP forecast

Afterwards, the same procedure was repeated to find the lag order of PC 1 to 7. The best model was determined to be ADL(2, (2, 1, 1, 1, 2, 1, 3)) with the lowest AIC. This ADL model has p lags of GDP and ql lags of PCs where l = 1 … k.

Forecast

To forecast Y_{t+h}, we recursively forecast and update new values of GDP and PCs into our model. This was first done by forecasting PC1 to 7 for 2025 Q1, Q2, Q4 by fitting the PCs into ARIMA models. Subsequently, forecasts of GDP were computed using our ADL model.

Findings

Based on the aforementioned methods, our results can be seen in Figures 5 and 6.

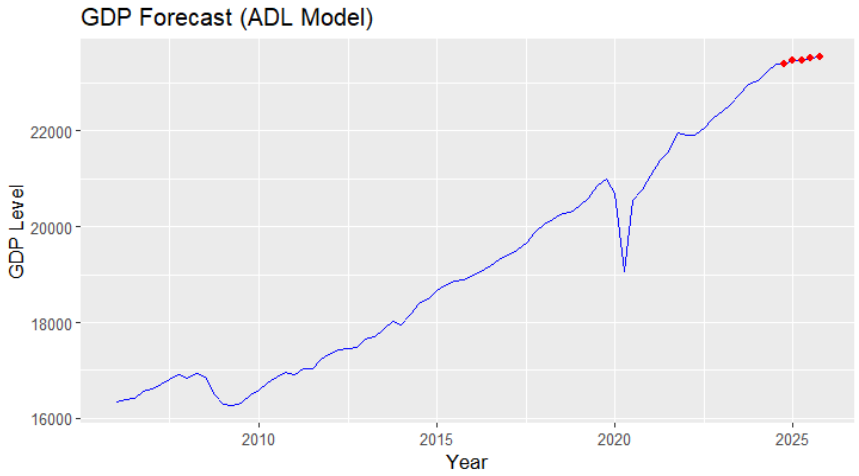

Fig. 5: GDP (Billions of 2017 Dollars) Forecast from ADL Model

Year & Quarter	GDP forecast (Billions of 2017 Dollars)
2024 Q4	23400.29
2025 Q1	23453.77
2025 Q2	23470.59
2025 Q3	23504.38
2025 Q4	23548.41

Fig. 6: Table of GDP (Billions of 2017 Dollars) forecast values

From these GDP forecasts, we took an average of GDP within a year from the quarter to be determined and compared it against our forecasted GDP quarter. We obtained positive GDP growth rates, hence there should be no economic contractions for Q1, Q2 and Q4 in 2025.

Conclusion

Ultimately, we forecasted that there should be no economic contraction in the U.S. in 2025. Given Singapore's small size and relatively high dependency on the U.S. economy, there should not be economic contraction in Singapore. This forecast is supported by the Monetary Authority of Singapore's current outlook. Furthermore, based on the outlook of Figure 5, while GDP is forecasted to increase, the GDP growth rate seems to be declining from 2025 onwards.

However, we acknowledge that we cannot be certain as there are many rapidly changing factors in the global economy that will affect the accuracy of our forecast.

References

FRED-QD. Federal Reserve Bank of St Louis.

MAS Monetary Policy Statement. (2025, January 24). Monetary Authority of Singapore.

Subhani, O. (2025, January 1). 'Economic trends to watch for Singapore in 2025'. The Straits Times. https://www.straitstimes.com/business/economic-trends-to-watch-for-singapore-in-2025

Hanck, C., Arnold, M., Gerber, A. & Schmelzer, M. (2024, February 13). Introduction to Econometrics with R. University of Duisburg-Essen. (ADL model codes, Chapter 14.0) 14 Introduction to Time Series Regression and Forecasting | Introduction to Econometrics with R

ChatGPT prompt on forecasting: How do I forecast for the principal components (PC1–PC7) and forecast for the GDP using my estimated ADL model. OpenAI.