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Economics 460

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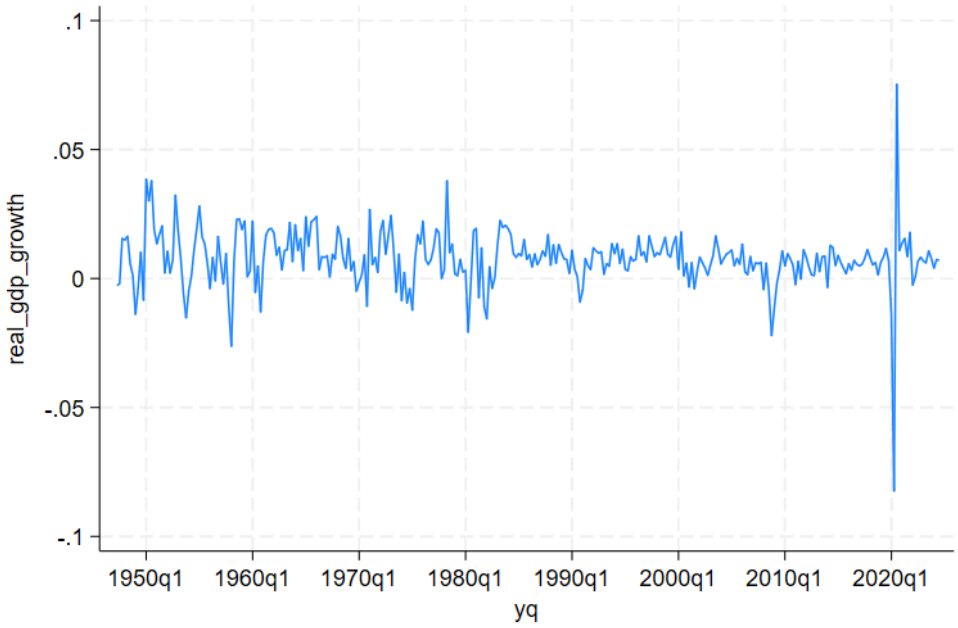
GDP Growth Rate Forecast Report

The macroeconomic variable that I decided to forecast is the real gross domestic product growth rate, which represents the change of gross domestic product, the total value of all goods and services produced in the United States. There are multiple ways to calculate the GDP of a country, and mainly two approaches are being used popularly. In an expenditure approach, GDP is calculated through the summation of consumer spending, total investment, total government spending, and net export. In an income approach, GDP is calculated through the summation of total national income, sales taxes, depreciation of the national currency, and net foreign factor income. As shown above, there are numerous variables that can influence the GDP of a country, and all of them together create many possible uncertainties. Therefore future GDP can be difficult to predict with great confidence.

I chose to deal with real GDP instead of nominal GDP because real GDP is a more accurate description of the economic performance of a country, since nominal GDP is distorted by inflation, meaning that the change in price level can affect the values presented in nominal GDP. In addition to the consideration of inflation, I am aware of the necessity to detrend the GDP. GDP report alone does not have mean stationarity, since there is typically a clear upward trend of a country unless going

through black swan events such as political turbulence, which is outside of the scope of forecast.

In order to forecast a primarily detrended time series, I chose to forecast the growth rate of real GDP instead, since there is no valid reason for the growth rate to have a specific growing or declining direction over time. I conducted an ADF test for the real GDP growth rate, and it turns out that the p value is 0.0009, which is less than 0.05, so I can reject the null hypothesis that the real GDP growth rate time series has a unit root, meaning that I can safely conclude that the time series is stationary and is safe to work with without further effort of detrending.



GDP growth rate is cyclical

I ran an Akaike's Information Criterion and Bayesian Information Criterion test on AR1 through AR4 to find out which one is the most ideal, and it turns out that the AIC selects AR2 with the least value of -1884.198, and the BIC selects AR1 with the least value of -1875.676. There was a debate between whether the AIC or the BIC should be

considered. As learned in the class, the two each have their own advantages and drawbacks. BIC is consistent and AIC is efficient. AIC focuses on minimizing error, and BIC imposes a larger penalty for more parameters. I ended up deciding to adopt the AIC selection since efficiency is much more valued when it comes to finding out the best model for the forecast.

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. estimates stats AR1 AR2 AR3 AR4

Akaike's information criterion and Bayesian information criterion
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Model	N	ll(null)	ll(model)	df	AIC	BIC
AR1	306	940.9129	943.5616	2	-1883.123	-1875.676
AR2	306	940.9129	945.0988	3	-1884.198	-1873.027
AR3	306	940.9129	945.2467	4	-1882.493	-1867.599
AR4	306	940.9129	945.9412	5	-1881.882	-1863.264

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Note: BIC uses N = number of observations. See [R] IC note.
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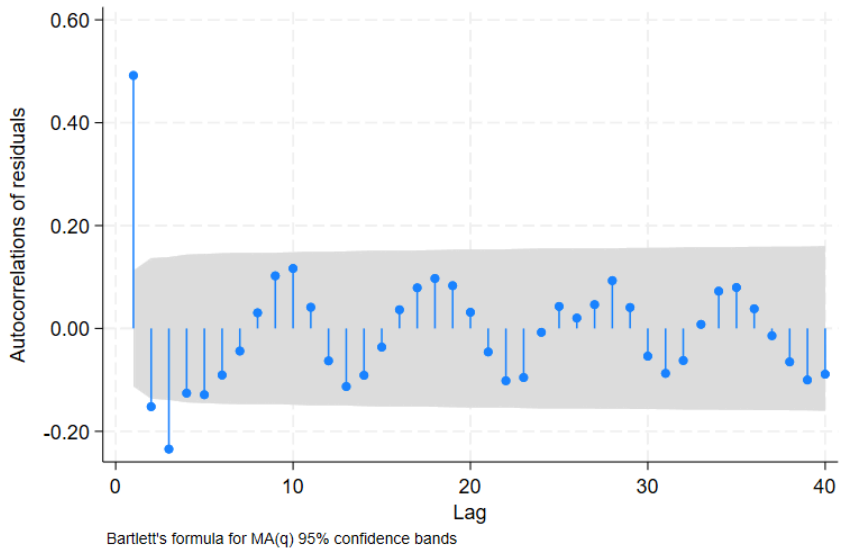
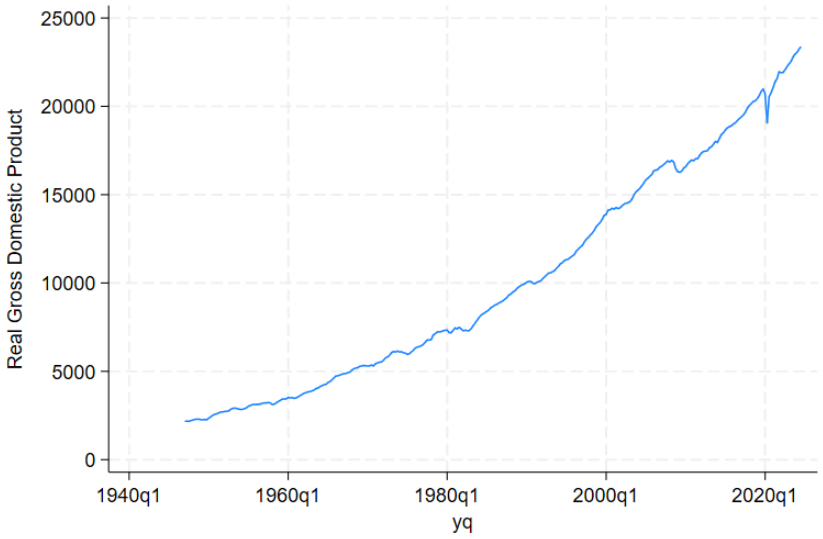
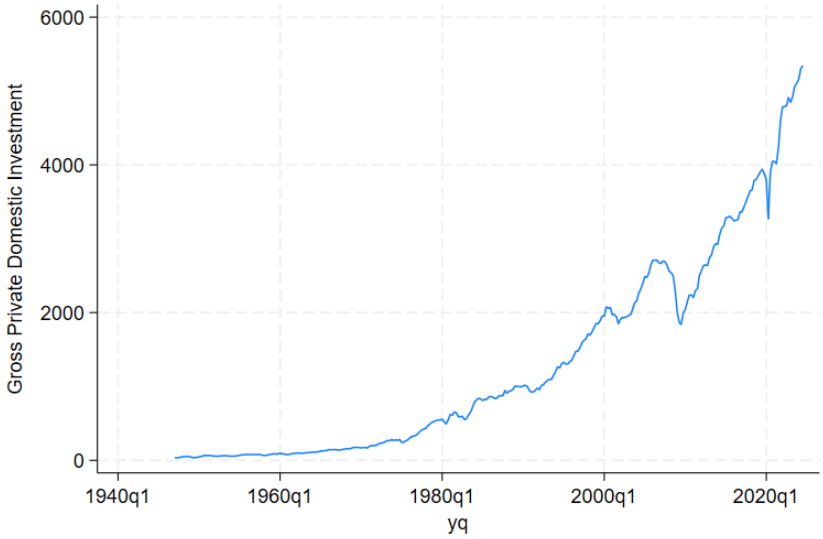
Since I chose to consider AIC over BIC, I will use AR2 as the model. I conducted a residual diagnostics and it appears that the residuals are white noise. As shown in the graph below.



An ADL model can work very well on real GDP growth rate since there are a variety of variables I can choose to see if they can influence the GDP growth rate. A variable that I believe influences the GDP growth rate a lot is the Gross Private Domestic Investment, being counted under the “investment” category when calculating GDP of a country. The graph of the GPDI times series has a similar trend with real GDP and I suspect that the two have a relationship of granger causality.





Driven by such a belief, I then conducted a granger causality test between the two times series with real GDP growth rate being the dependent variable and GPDI being the independent variable. As shown in the graph, the p value of GPDI granger causing GDP growth rate is 0.01, which is below 0.05, meaning that GPDI granger causes GDP growth rate. At the same time, the p value of GDP growth rate granger causing GPDI is 0.397, which is way above 0.05, meaning that GDP growth rate does not granger cause GPDI, also implies that the test is valid and trustworthy.

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. vargranger

  Granger causality Wald tests
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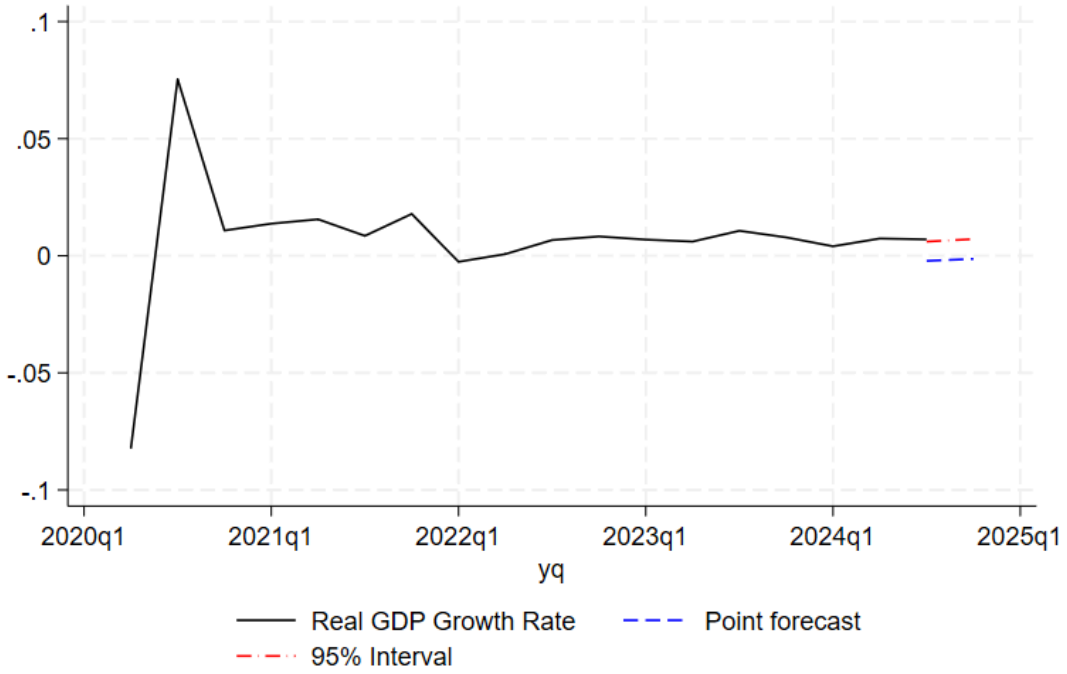
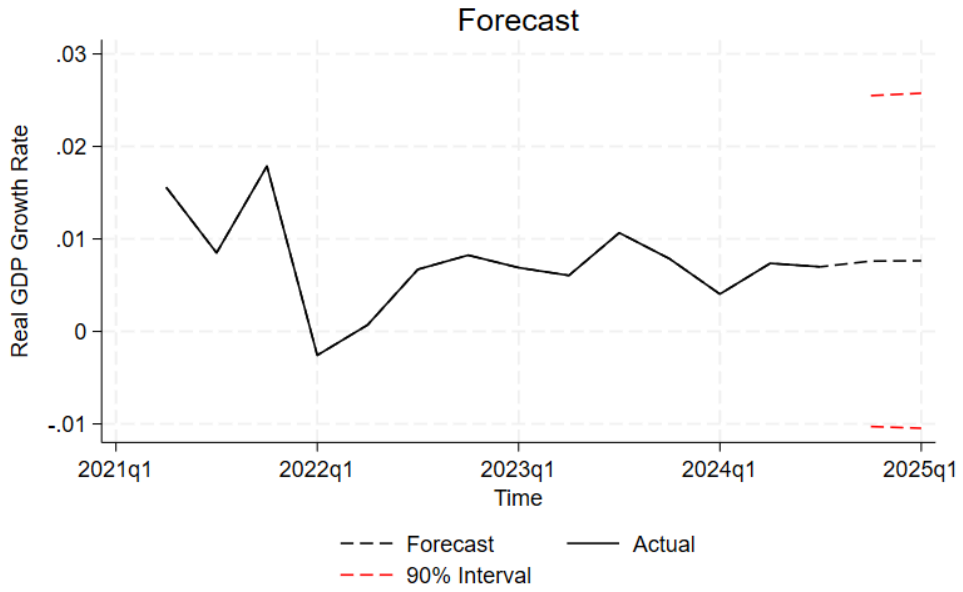
Equation	Excluded	chi2	df	Prob > chi2
real_gdp_growth	GPDI	9.169	2	0.010
real_gdp_growth	ALL	9.169	2	0.010
GPDI	real_gdp_growth	1.8477	2	0.397
GPDI	ALL	1.8477	2	0.397

And based on the guarantee of stationarity mentioned earlier, a forecast based on the ADL model is now made possible. I then conducted the ADL forecast and the result is shown below:



As forecasted by the ADL model with Gross Private Domestic Investment being the independent variable, GDP growth is expected to decline by a small margin and then continue to smooth out in a positive direction.

I also conducted an ARIMA model to forecast in order to distinguish the differences of results between the two models, ADL and ARIMA. As selected above, AR(2) will be the superior one to use for this ARIMA forecast. I implemented ARIMA(2,0,0) and got the result below:



As shown in the graph above, real GDP growth is in fact expected to grow slightly in an upward direction. This result, in some sense, contradicts with the result of the ADL model. It is therefore critical to find out which of the two is optimal and more reliable.

The obvious characteristic of ARIMA is that it solely relies on one time series itself without any assisting source of outside information as an argument. It is therefore much simpler than the ADL model to conduct. It is suggested that the ARIMA model can still be used for non-stationary data, meaning that it has a relatively wider range of applications and lower standard for time series. However, the time series that I forecasted, the real GDP growth rate, is stationary itself, meaning that the functionality of the ARIMA model of surviving non-stationary data is unnecessary and inefficient. In this particular case of finely structured time series, the advantage of the ARIMA model over the ADL model is being smoothed and ignored. On the other hand, the ADL model has proven its superiority over the ARIMA model for the following few reasons. First of

all, having an extra variable to serve as the backing makes the forecast much more complete with a greater scope. Certainly, such assisting data is not always available for all macroeconomic variables since certain variables can be relatively free from being influenced by other real world factors, so in my opinion, it further proves the luxury of this ADL forecast I conducted where a practical and well-functioned variable like Gross Private Domestic Investment plays its part efficiently. The granger causality as the first step in ADL forecasting puts a high barrier for entry, therefore a high reliability.

In conclusion, in forecasting the GDP growth rate of a country, the ADL model functions better and can have a relatively more credible result.