Forecasting GDP

By: Davis Kim & Chris Hole
Economics 460
University of Wisconsin-Madison
April 28th, 2020

Our dataset consists of percent change in GDP data from the Bureau of Economic Analysis. It contains two time series quarterly GDP in current dollar value and quarterly GDP in chained 2012 dollars. Both of these series start in the first quarter of 1947 and continue through the fourth quarter of 2019. In this report, we will be attempting to forecast GDP for the first four quarters of 2020. To do this we will be creating a forecasting model using the percent change in current dollars. Below, we plotted the original series with mean in figure 1. This series suggested trended and cyclical patterns.

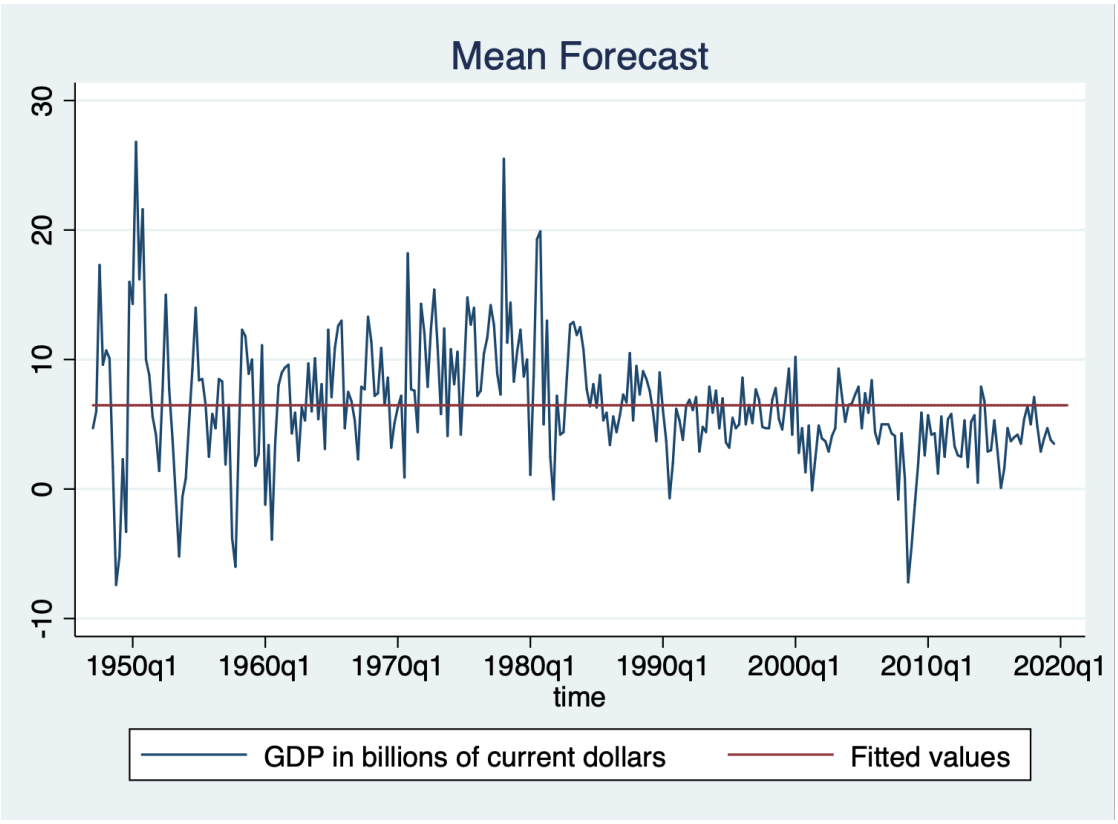

Figure 1: Point and 90% Interval Forecast

In order to capture our cyclical component, we tested our model using four lags and used AIC and BIC to determine which AR(p) model was the best. From our results, found in table 1, you can see that AIC and BIC both select the AR(3) model.

Model	Observations	ll(null)	ll(model)	df	AIC	BIC
AR(0)	286	-844.4669	-835.6651	2	1675.33	1682.642
AR(1)	286	-844.4669	-801.2307	3	1608.461	1619.429
AR(2)	286	-844.4669	-797.1186	4	1602.237	1616.861
AR(3)	286	-844.4669	-793.9062	5	1597.812	1616.092
AR(4)	286	-844.4669	-793.7397	6	1559.479	1621.415

Table 1: Model Selection

Our AR(3) model had an R-squared value of 0.2978, and is estimated from the following equation:

$$y_t = 3.9569 - 0.007081t + 0.4099y_{t-1} + 0.2253y_{t-2} - 0.1479y_{t-3} \quad \text{(eq. 1)}$$

The coefficients found in the table 2. We also ran a F-Test to test for joint significance with the A(3) model. The test returned a p-value of 0.00 which is less than 0.05; therefore, we reject the null hypothesis and conclude that time and the previous three periods help predict the GDP growth.

GDP	Coefficient	Standard Error	t-statistic
Time	-.0070808	.0029549	-2.40
GDP.L1	0.4099269	0.0589914	6.95
GDP.L2	0.2252756	0.0623455	3.61
GDP.L3	-0.1479401	0.0585522	-2.53
Constant	3.956869	0.6230121	6.35

Table 2: Regression Output

Using an AR(3) regression model, we created a point forecast and interval forecast for the four quarters of 2020. Our forecast estimates can be found in the table below accompanied by a graph. For the first quarter we estimate GDP to rise 3.88% with a confidence level of 90% that the true percent change will fall between -2.59% and

10.36%. The second quarter, we estimate GDP to rise by 4.07% and with a 90% confidence that the true percent change will be within -2.92% and 11.06%. For the third quarter, we estimate GDP to rise by 4.23%, with 90% confidence that the true value will be within the range of -3.15% and 11.62%. Finally, we estimate a rise of 4.45% in GDP, with 90% confidence that the true percent change in GDP will be between -3.0% and 11.90%. These results are summarized in table 3.

Quarter	Point Forecast	Lower 90% Confidence Interval	Upper 90% Confidence Interval
2020Q1	3.885443	-2.588038	10.35892
2020Q2	4.065881	-2.924498	11.05626
2020Q3	4.232475	-3.152768	11.61772
2020Q4	4.451007	-2.999579	11.90159

Table 3: Point and Interval Forecast for 2020Q1 to 2020Q4

When visualizing our forecast, we plotted both the upper and lower bound of our intervals and the point forecast in figure 2. We also included the data from (2013Q1 - Present) of the original series. The forecast interval increases in size as the model moves to future quarters due to the increasing uncertainty of the projection.

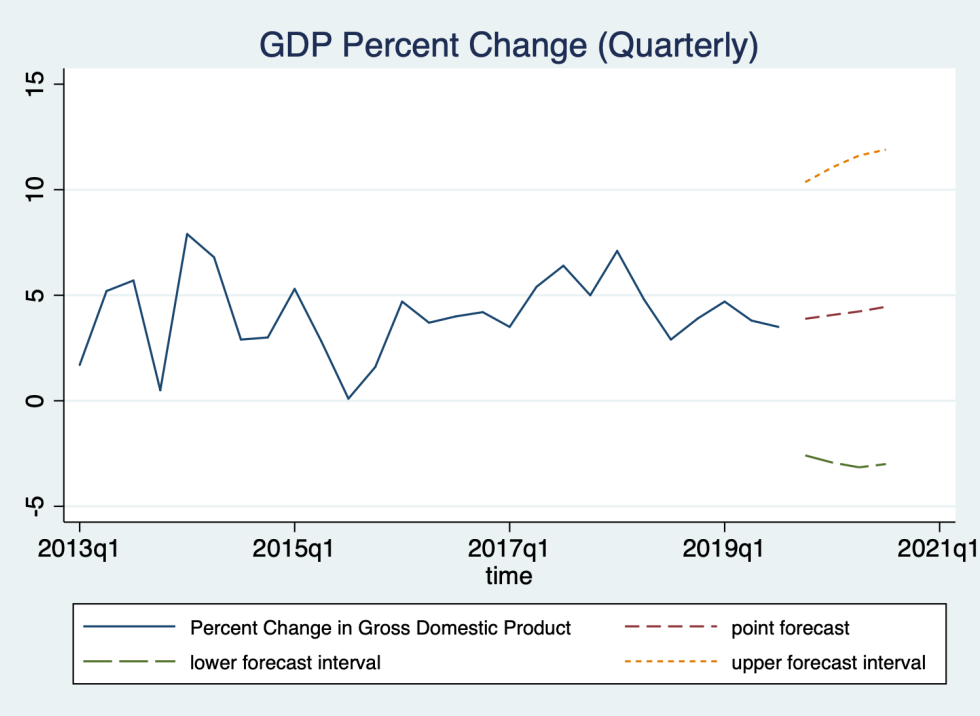

Figure 2: Point and 90% Interval Forecast

In conclusion, our model is very robust and there is a large range of possible values for GDP within our 90% confidence interval. The intervals are large likely because of the volatility shown in the historical series, but in practice the real data should hopefully land closer to the point forecast not the interval bounds.

Appendix

Figure 1:

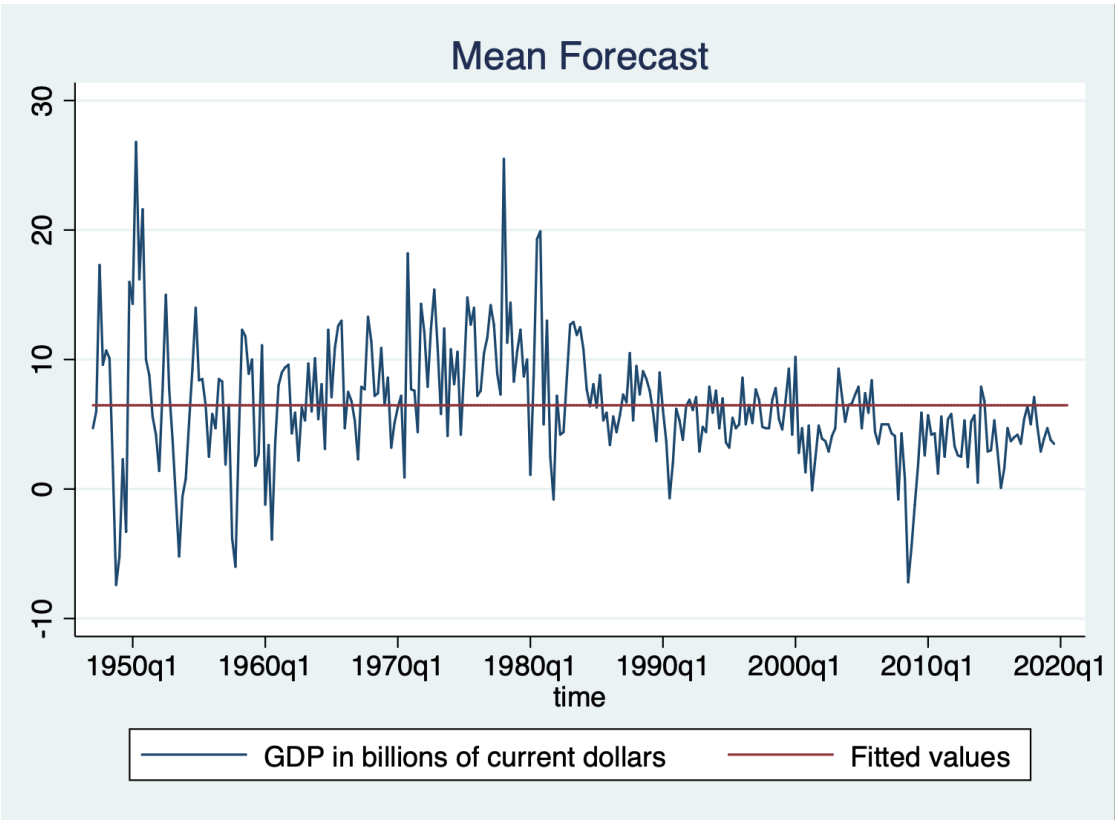

Figure 1: Point and 90% Interval Forecast

Table 1:

Model	Observations	ll(null)	ll(model)	df	AIC	BIC
AR(0)	286	-844.4669	-835.6651	2	1675.33	1682.642
AR(1)	286	-844.4669	-801.2307	3	1608.461	1619.429
AR(2)	286	-844.4669	-797.1186	4	1602.237	1616.861
AR(3)	286	-844.4669	-793.9062	5	1597.812	1616.092
AR(4)	286	-844.4669	-793.7397	6	1559.479	1621.415

Table 1: Model Selection

Equation 1:

$$y_t = 3.9569 - 0.007081t + 0.4099y_{t-1} + 0.2253y_{t-2} - 0.1479y_{t-3}$$

Table 2:

GDP	Coefficient	Standard Error	t-statistic
Time	-.0070808	.0029549	-2.40
GDP.L1	0.4099269	0.0589914	6.95
GDP.L2	0.2252756	0.0623455	3.61
GDP.L3	-0.1479401	0.0585522	-2.53
Constant	3.956869	0.6230121	6.35

Table 2: Regression Output

Table 3:

Quarter	Point Forecast	Lower 90% Confidence Interval	Upper 90% Confidence Interval
2020Q1	3.885443	-2.588038	10.35892
2020Q2	4.065881	-2.924498	11.05626
2020Q3	4.232475	-3.152768	11.61772
2020Q4	4.451007	-2.999579	11.90159

Table 3: Point and Interval Forecast for 2020Q1 to 2020Q4

Figure 2:

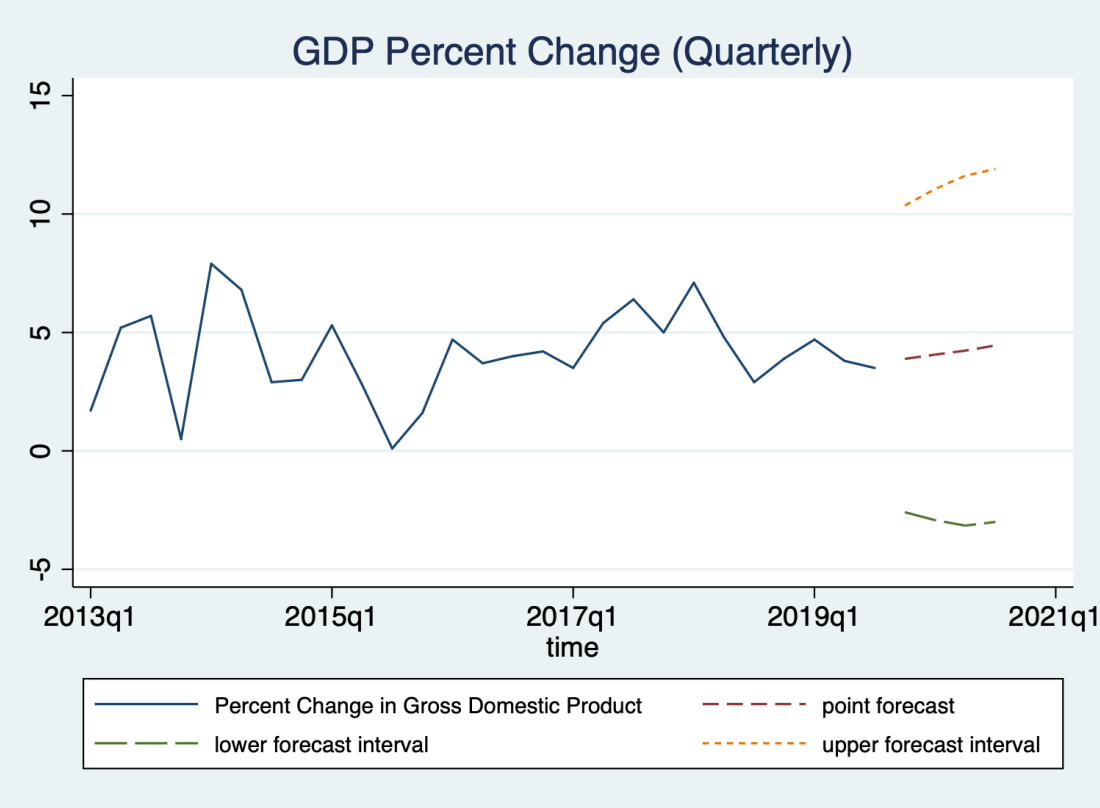

Figure 2: Point and 90% Interval Forecast