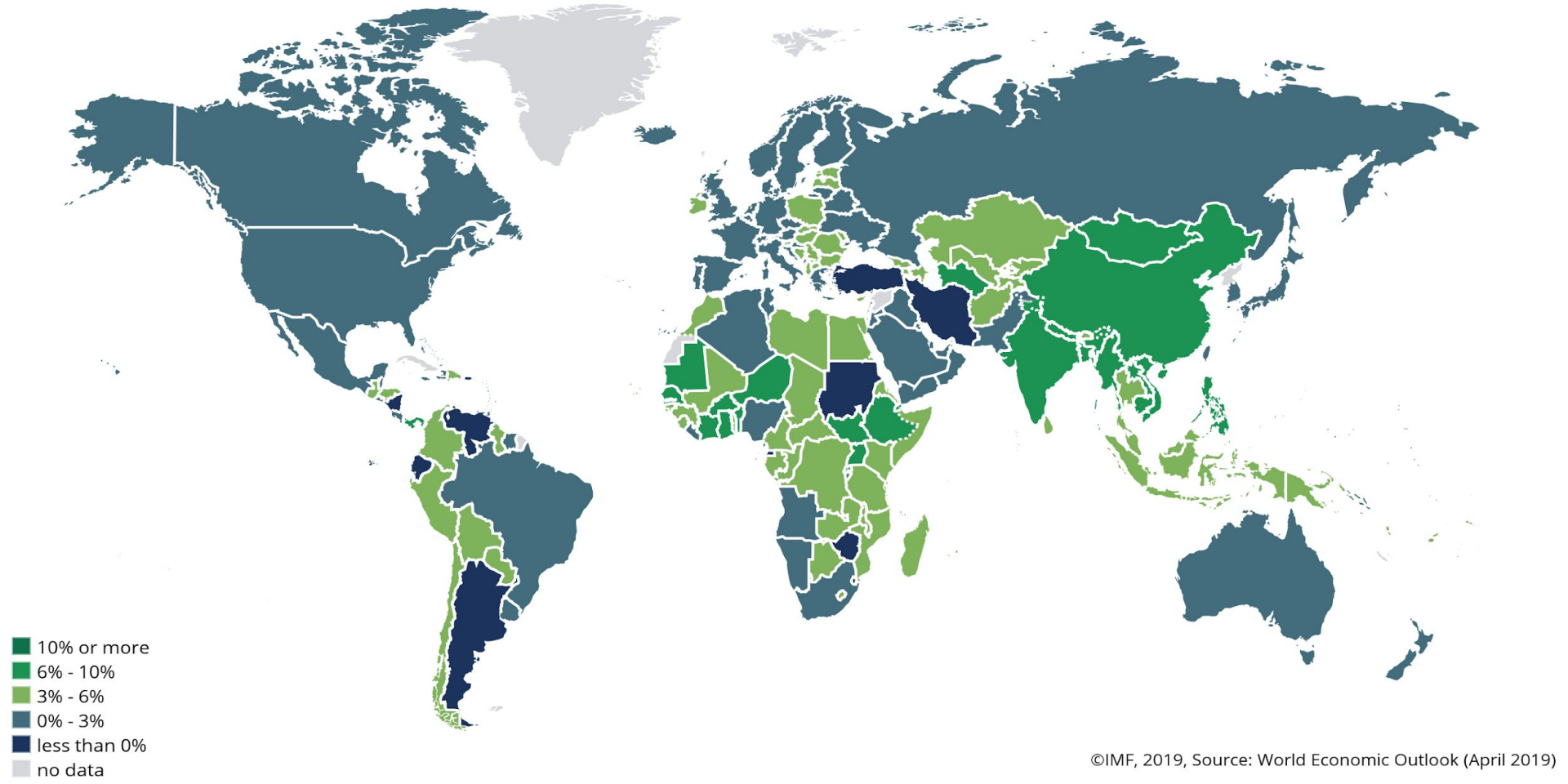
IMF DataMapper

Real GDP growth (Annual percent change, 2019)



How SUITABLE are TIME SERIES MODELS in prediction global economic measures?

Kiryl Pashkouski, ds-042219
08/01/2019

OBJECTIVES:

1) Apply statistical methods for the analysis of data observed over time;

2) Model time series data with Autoregressive and Moving Average Models;

3) Use methods for estimation of assessment of the suitability of the model;

Short answer:

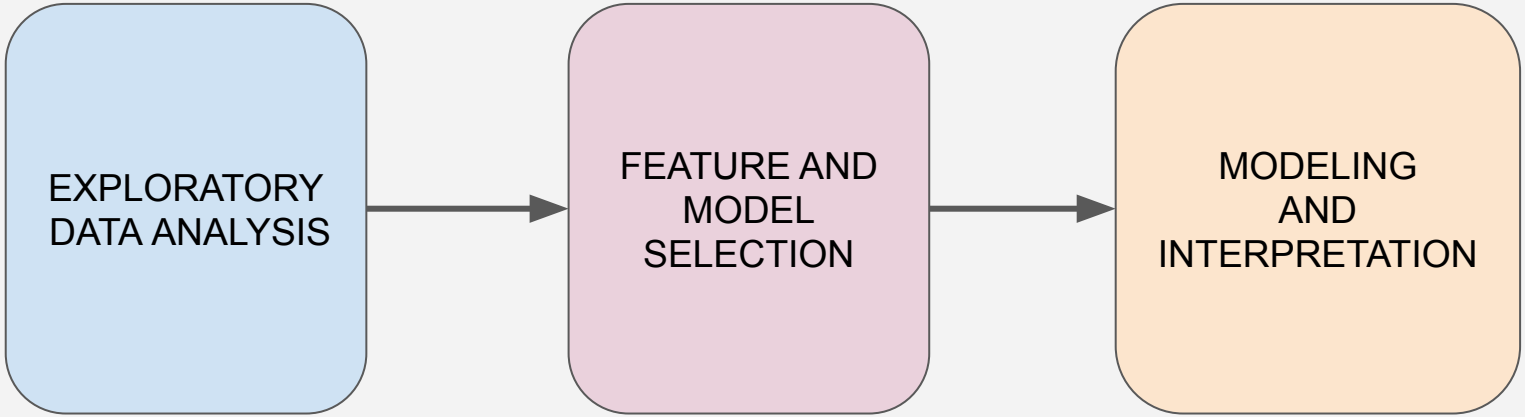
Yes, it’s acceptable

Long answer:

NO,

we shouldn’t use them

STEPS:


EXPLORATORY DATA ANALYSIS
FEATURE AND MODEL SELECTION
MODELING AND INTERPRETATION

Glossary:

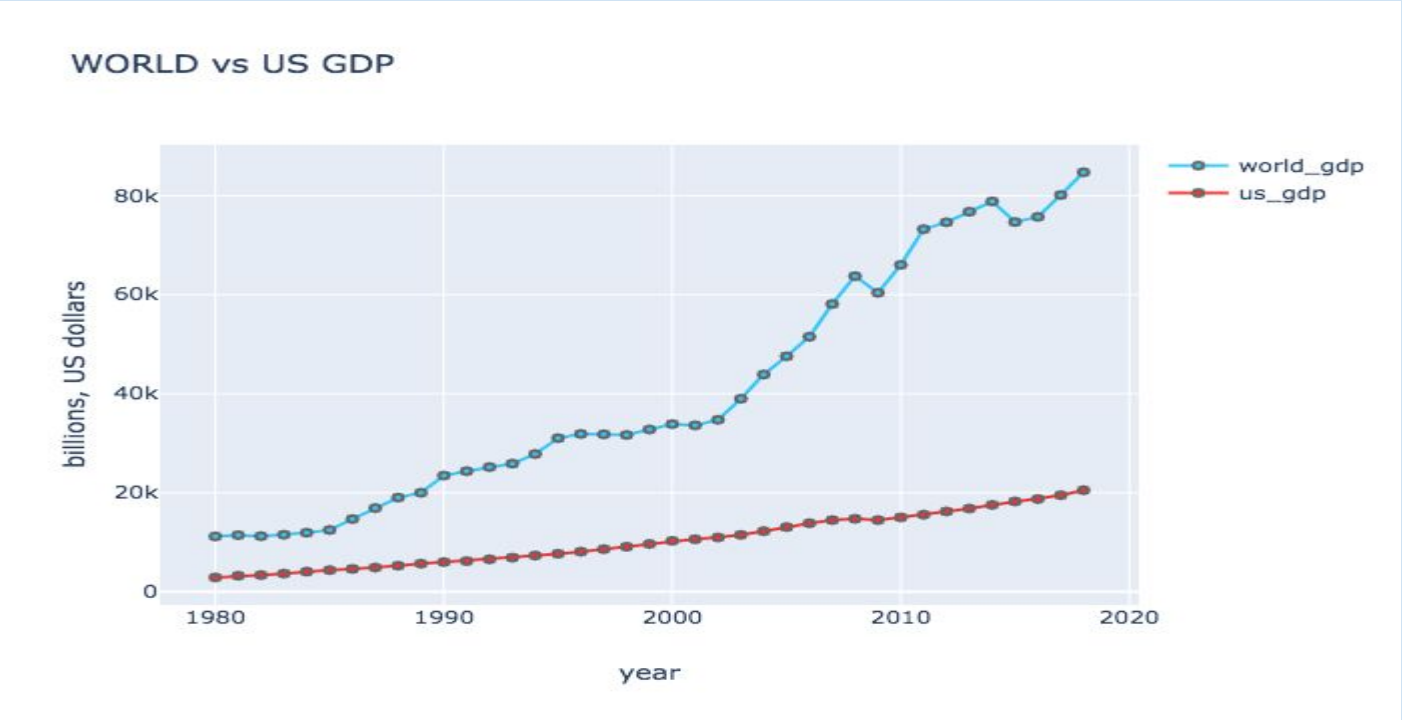
Univariate time series: a sequence of measurements of the same variable collected over time.

Gross domestic product (GDP): a monetary measure of the market value of all the final goods and services produced in a specific time period;

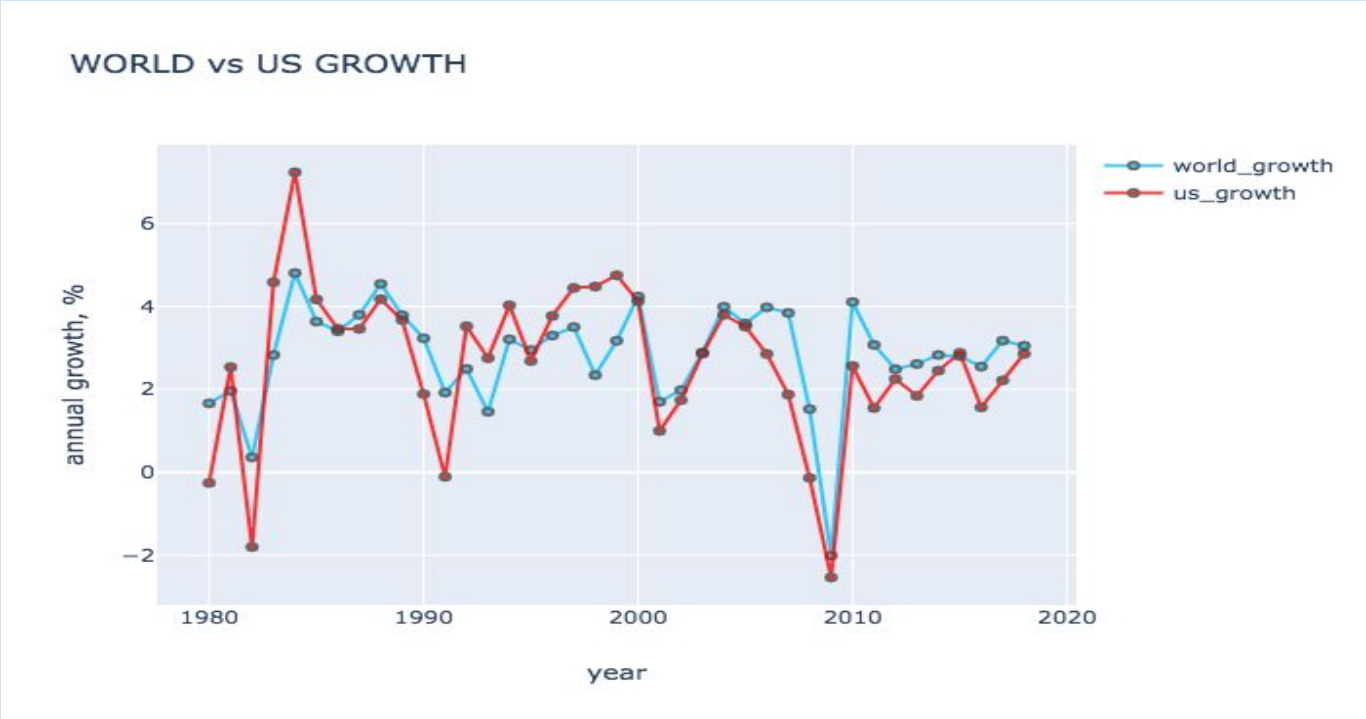
GDP growth rate: measures how fast the economy is growing, comparing one year of the country's **GDP** to the previous year.

Akaike information criterion (AIC): an estimator of the relative quality of statistical models for a given set of data;

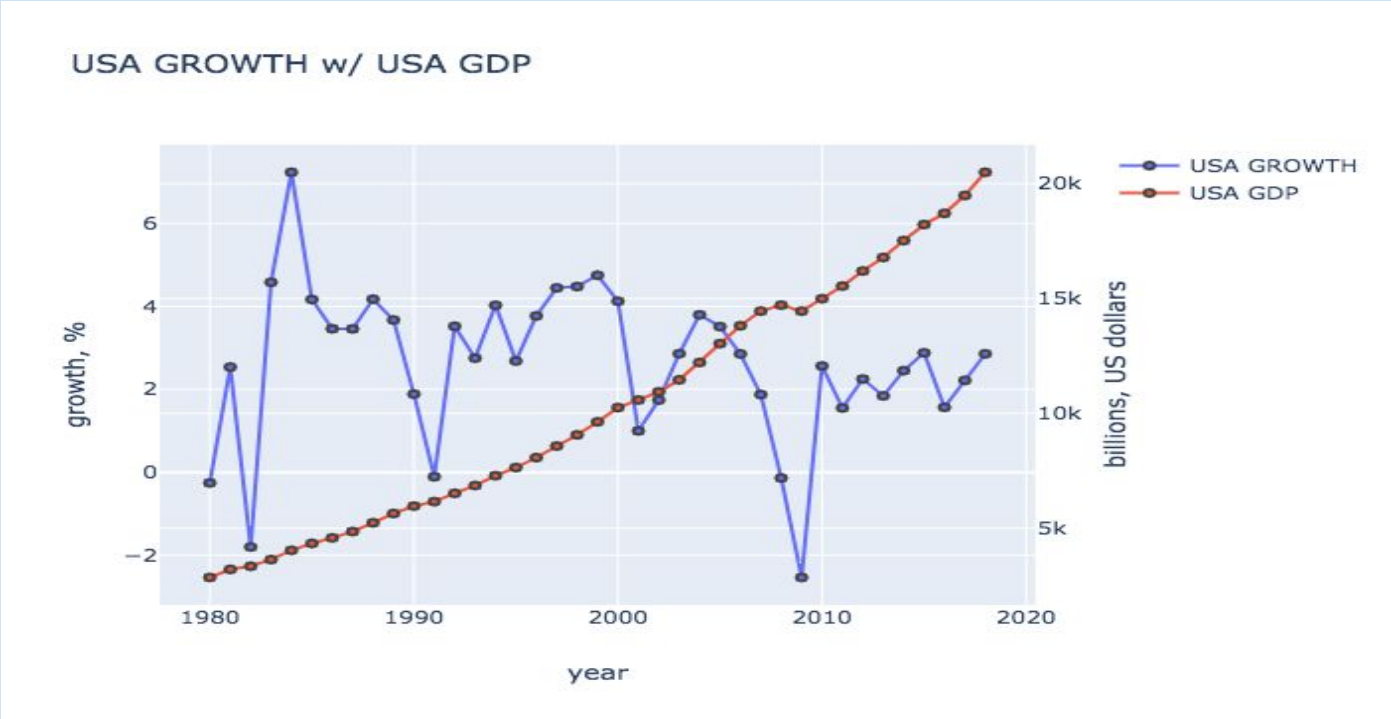
World GDP vs USA GDP

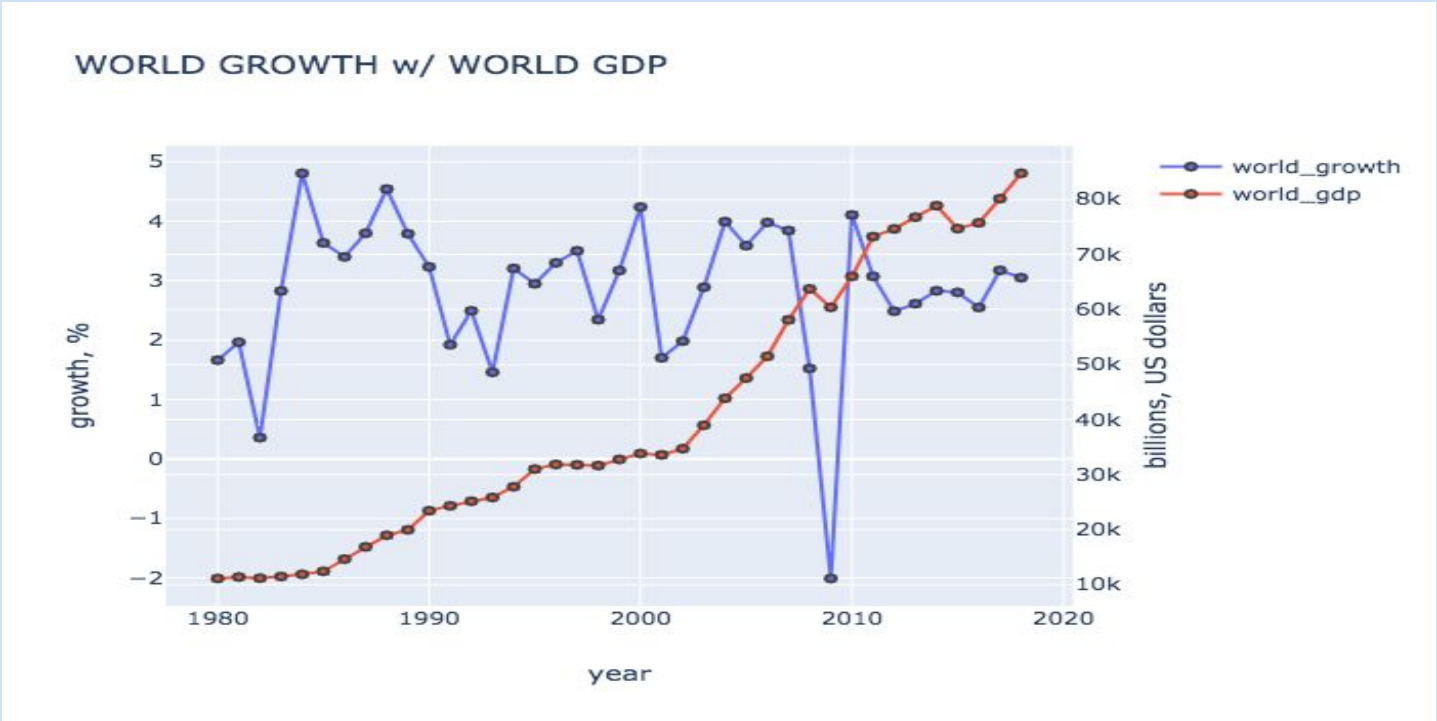


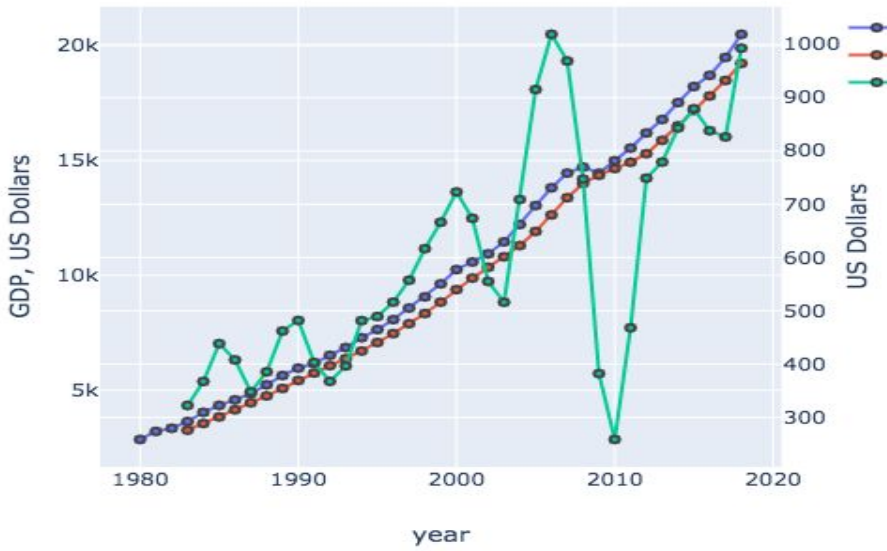
World Growth vs USA Growth



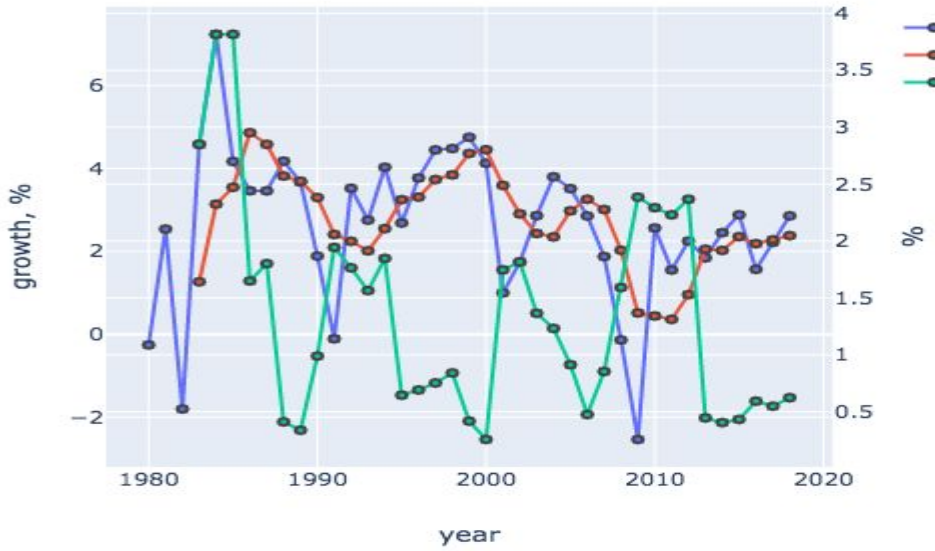
USA Growth vs USA GDP




WORLD GROWTH w/ WORLD GDP
growth, %
billions, US dollars
year
world_growth
world_gdp
5
4
3
2
1
0
−1
−2
80k
70k
60k
50k
40k
30k
20k
10k
1980
1990
2000
2010
2020




```
Results of Dickey-Fuller Test:
Test Statistic                   2.544136
p-value                          0.999063
#Lags Used                       2.000000
Number of Observations Used     36.000000
Critical Value (1%)             -3.626652
Critical Value (5%)             -2.945951
Critical Value (10%)            -2.611671
dtype: float64
```

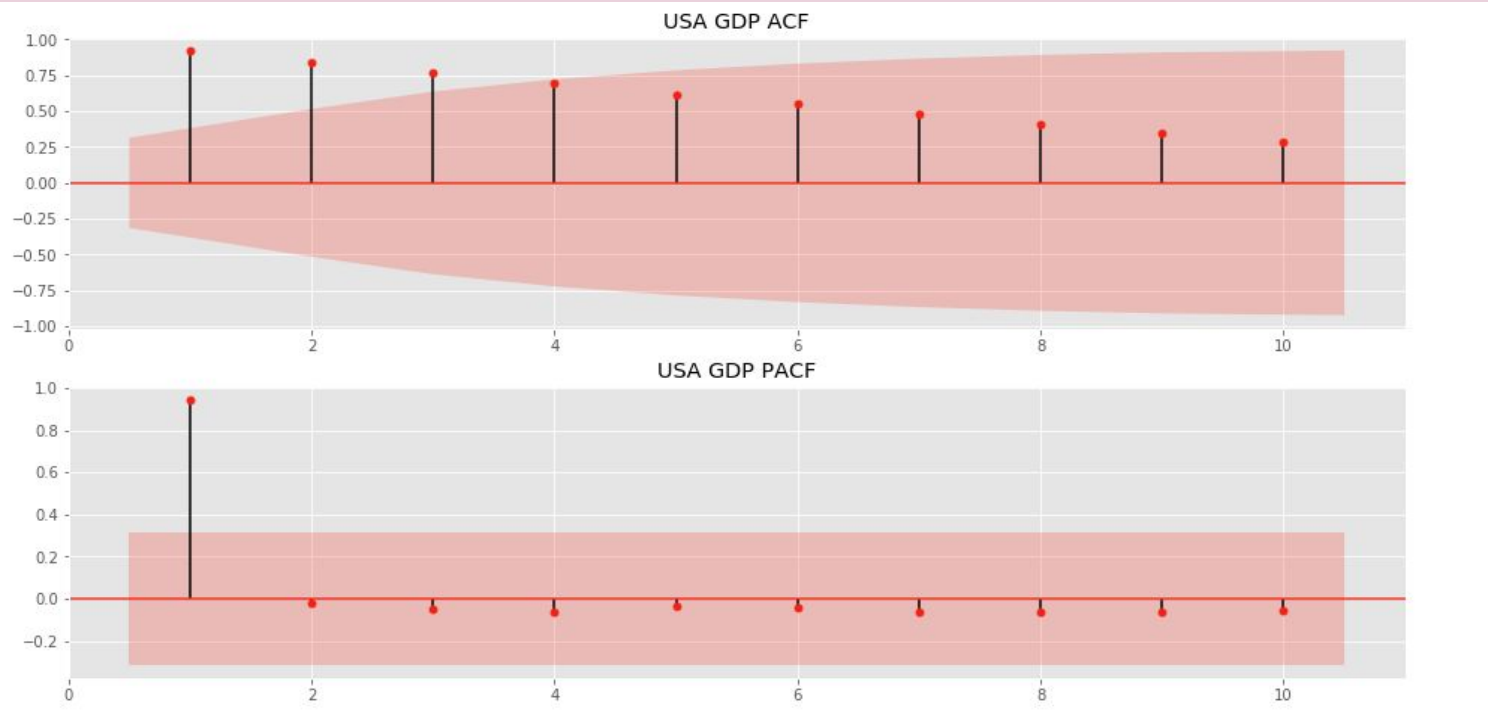



```
Results of Dickey-Fuller Test:
Test Statistic                  -4.434479
p-value                          0.000258
#Lags Used                       0.000000
Number of Observations Used     38.000000
Critical Value (1%)             -3.615509
Critical Value (5%)             -2.941262
Critical Value (10%)            -2.609200
dtype: float64
```

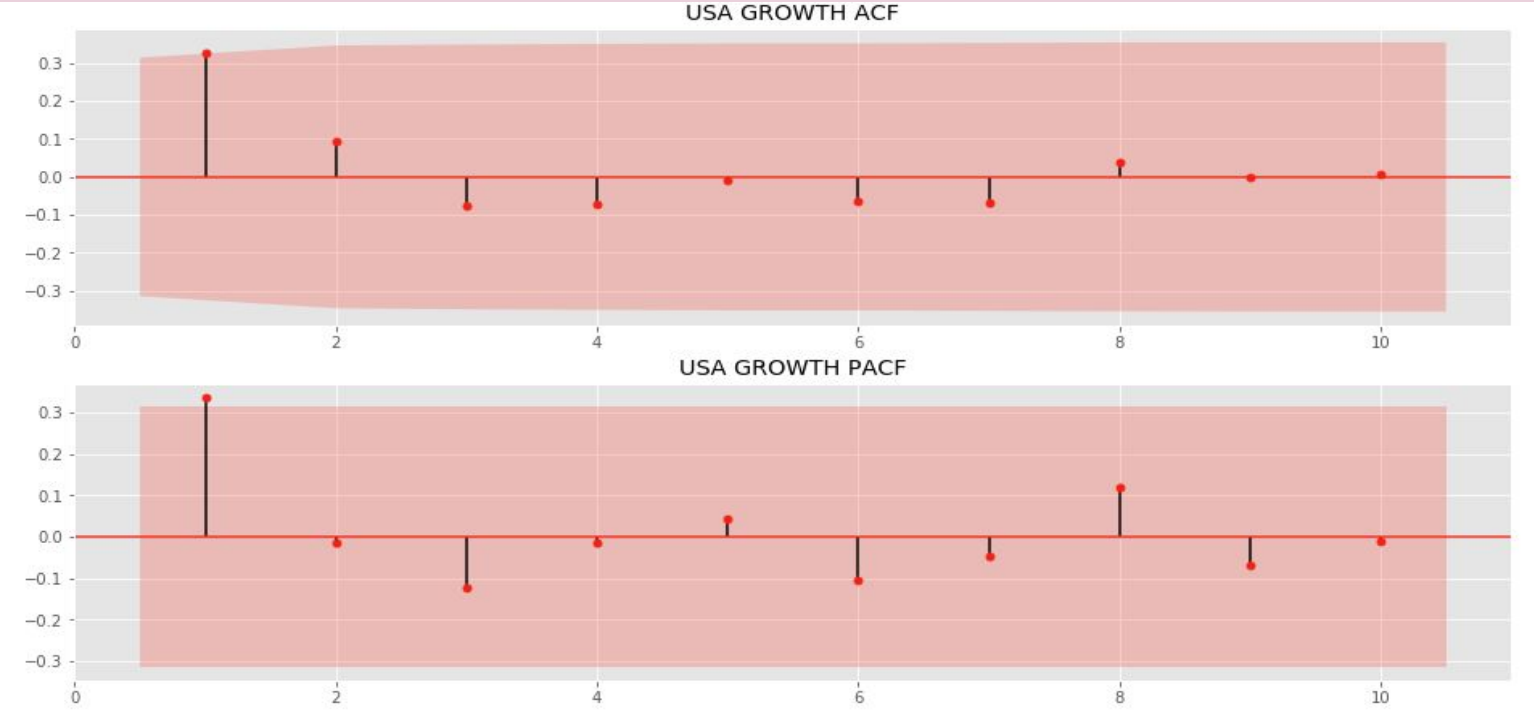

```
Results of Dickey-Fuller Test:
Test Statistic                    1.357629
p-value                           0.996913
#Lags Used                        0.000000
Number of Observations Used      38.000000
Critical Value (1%)              -3.615509
Critical Value (5%)              -2.941262
Critical Value (10%)             -2.609200
dtype: float64
```


```
Results of Dickey-Fuller Test:
Test Statistic                  -4.584593
p-value                          0.000138
#Lags Used                       1.000000
Number of Observations Used     37.000000
Critical Value (1%)             -3.620918
Critical Value (5%)             -2.943539
Critical Value (10%)            -2.610400
dtype: float64
```

US GDP


USA GDP ACF
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00
0
2
4
6
8
10
USA GDP PACF
1.0
0.8
0.6
0.4
0.2
0.0
−0.2
0
2
4
6
8
10

US GROWTH



STEP_3

US GDP

Statespace Model Results

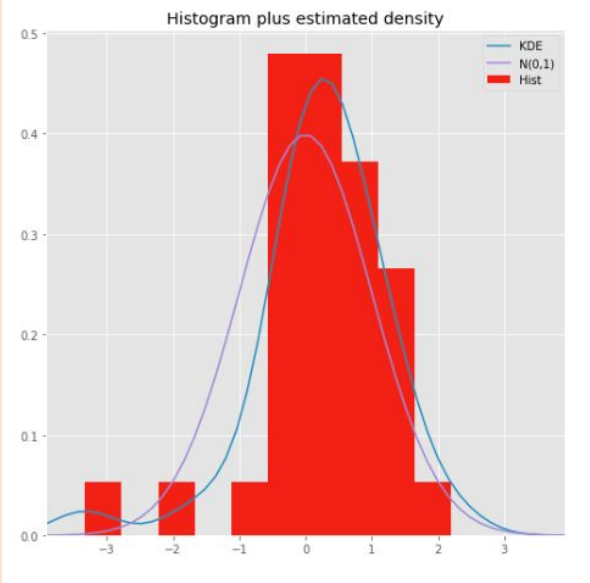
Dep. Variable:	US_GDP	No. Observations:	39
Model:	SARIMAX(0, 2, 2)	Log Likelihood	-228.070
Date:	Wed, 31 Jul 2019	AIC	462.141
Time:	15:17:34	BIC	466.720
Sample:	01-01-1980	HQIC	463.702
	- 01-01-2018		
Covariance Type:	opg		

	coef	std err	z	P>|z|	[0.025	0.975]
ma.L1	-0.3821	0.125	-3.048	0.002	-0.628	-0.136
ma.L2	-0.3664	0.197	-1.858	0.063	-0.753	0.020
sigma2	3.896e+04	9139.389	4.263	0.000	2.11e+04	5.69e+04

Ljung-Box (Q):	nan	Jarque-Bera (JB):	28.55
Prob(Q):	nan	Prob(JB):	0.00
Heteroskedasticity (H):	17.03	Skew:	-1.30
Prob(H) (two-sided):	0.00	Kurtosis:	6.66

Warnings:
[1] Covariance matrix calculated using the outer product of gradients (complex-step).

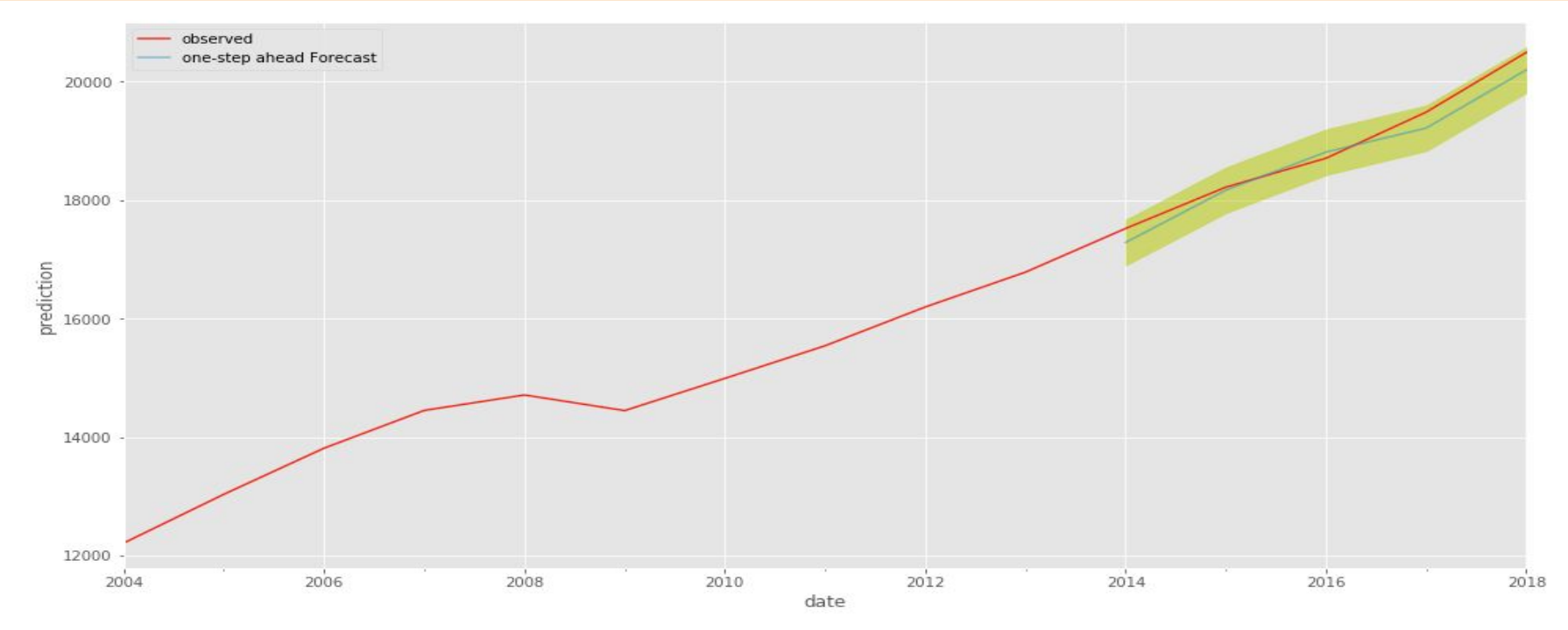
```
COMBINATION    (0, 2, 2)
AIC                498.281
Name: 8, dtype: object
 COMBINATION    (0, 2, 2)
BIC                504.725
Name: 8, dtype: object
```



Interpretation

US GDP

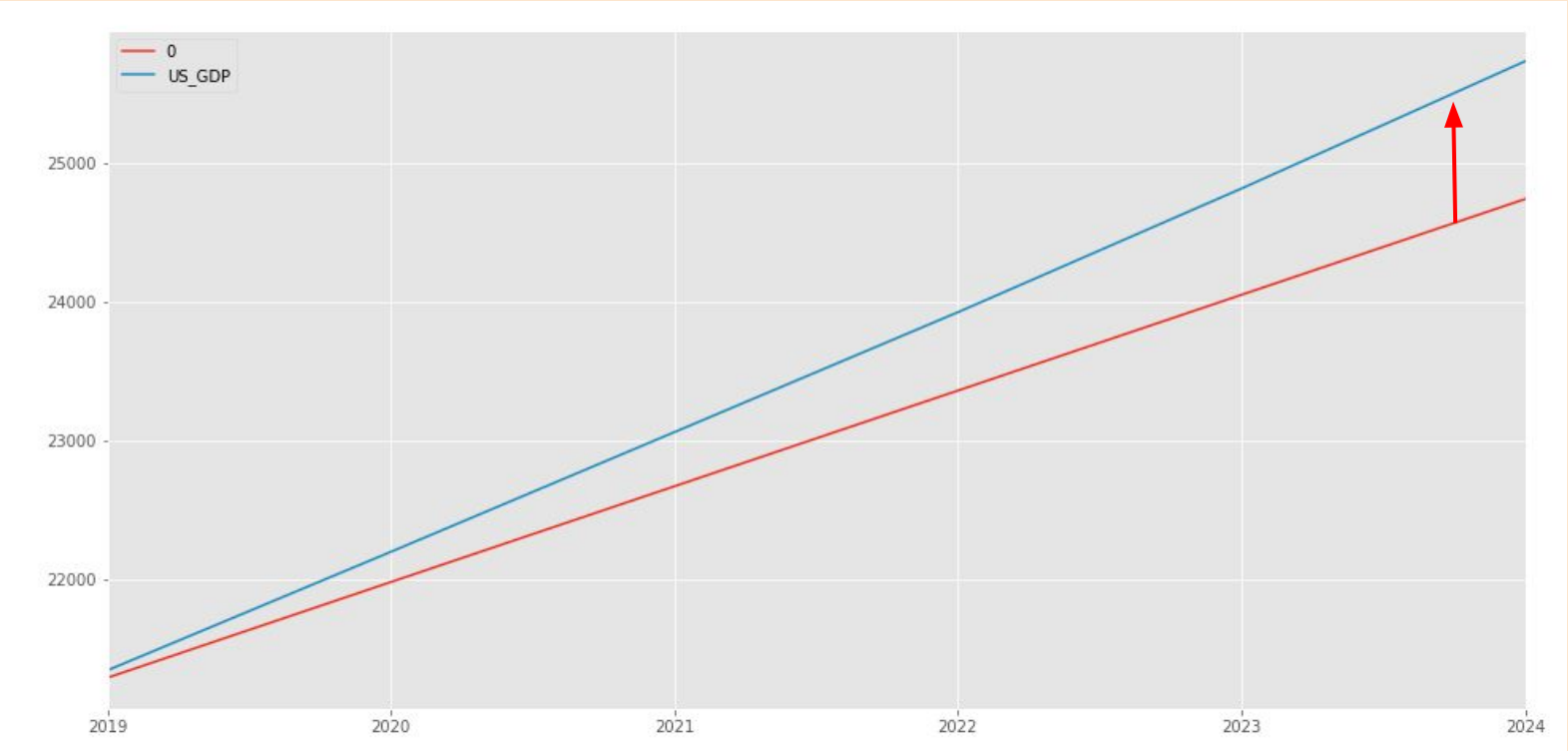
MSE=
213.75



Interpretation

US GDP

MSE=
590.06



Interpretation

US GROWTH

```
COMBINATION     (0, 1, 2)
AIC                 133.8
Name: 5, dtype: object
 COMBINATION     (0, 1, 2)
BIC                138.466
Name: 5, dtype: object
```

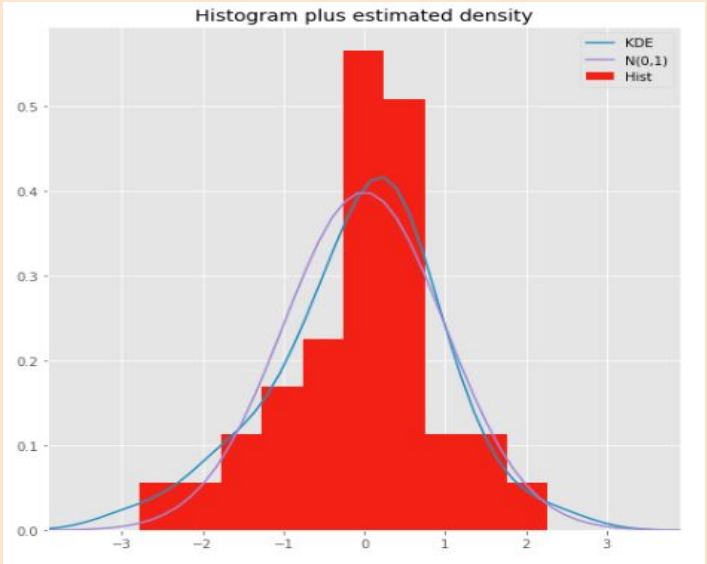
Statespace Model Results

Dep. Variable:	US_GROWTH	No. Observations:	39
Model:	SARIMAX(0, 1, 2)	Log Likelihood	-63.900
Date:	Wed, 31 Jul 2019	AIC	133.800
Time:	15:23:43	BIC	138.466
Sample:	01-01-1980	HQIC	135.410
	- 01-01-2018		
Covariance Type:	opg		

	coef	std err	z	P>|z|	[0.025	0.975]
ma.L1	-0.4660	0.148	-3.159	0.002	-0.755	-0.177
ma.L2	-0.4213	0.139	-3.024	0.002	-0.694	-0.148
sigma2	2.1860	0.574	3.807	0.000	1.060	3.312

Ljung-Box (Q):	nan	Jarque-Bera (JB):	1.73
Prob(Q):	nan	Prob(JB):	0.42
Heteroskedasticity (H):	1.22	Skew:	-0.46
Prob(H) (two-sided):	0.73	Kurtosis:	3.58

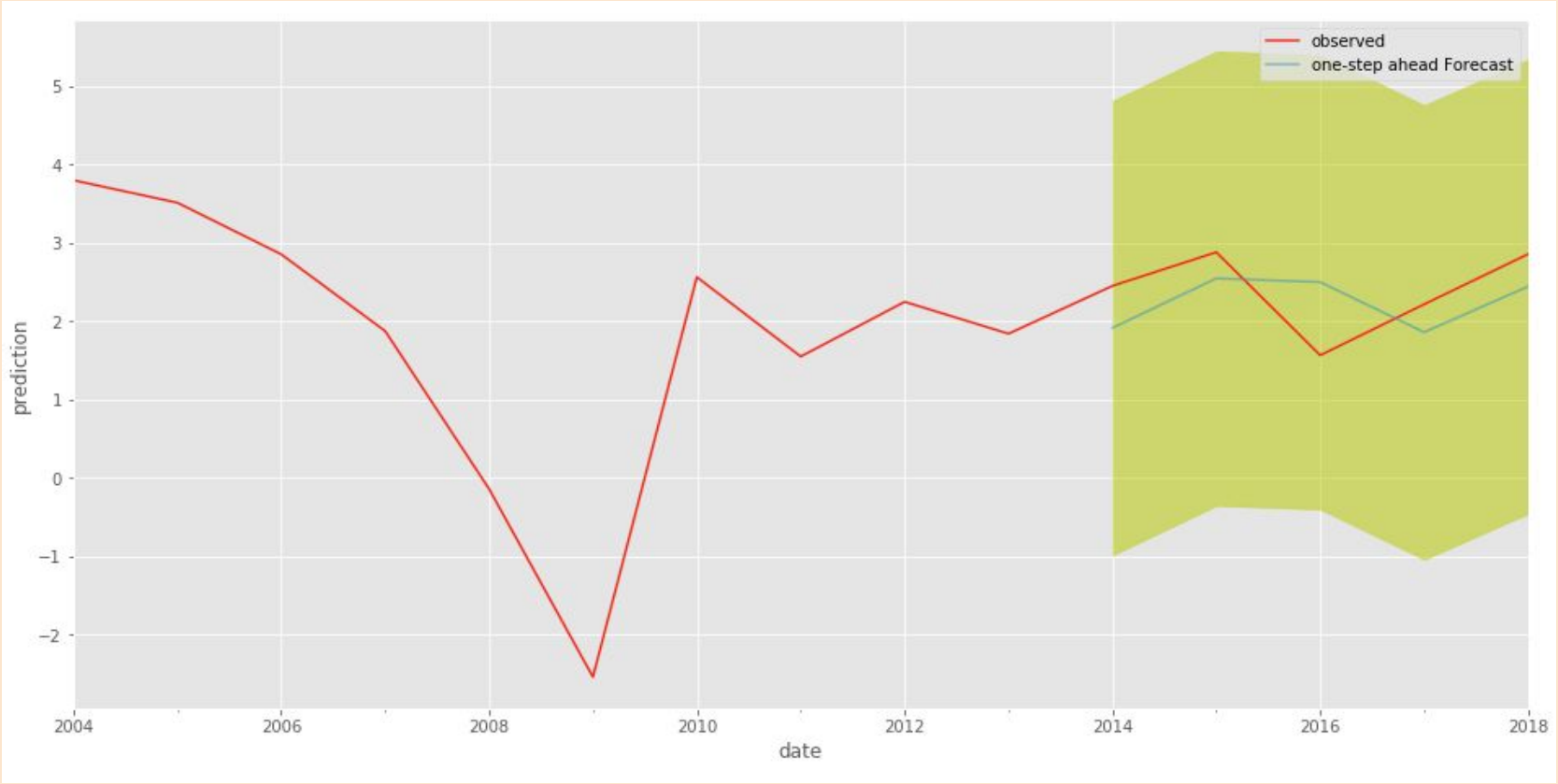
Warnings:
[1] Covariance matrix calculated using the outer product of gradients (complex-step).



Interpretation

US GROWTH

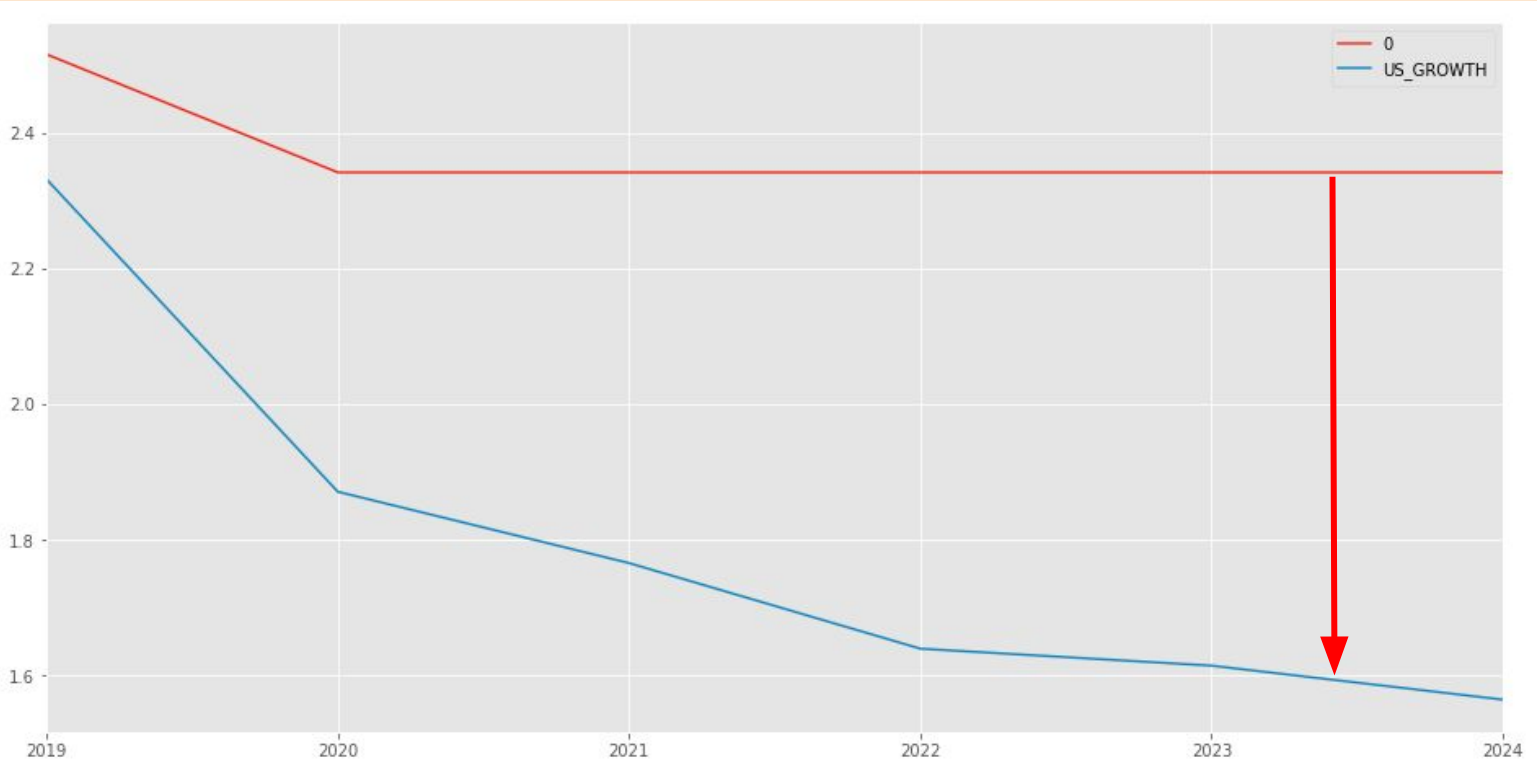
MSE= .56



Interpretation

US GROWTH

MSE= .61



Interpretation

GDP, current prices (Billions of U.S. dollars, 2019)

THANKS FOR LISTENING!