WTI OIL

Forecasting

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Objective, Questions and Outline

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Objective: Make a prediction of oil prices and perform scenario analysis

Questions:

1. Find the best model for oil price prediction
2. Predict oil prices in different economic scenarios

Outline:

- Overview of time series
- Model without regressors
- Model with regressors
- Scenario analysis

Overview of time series

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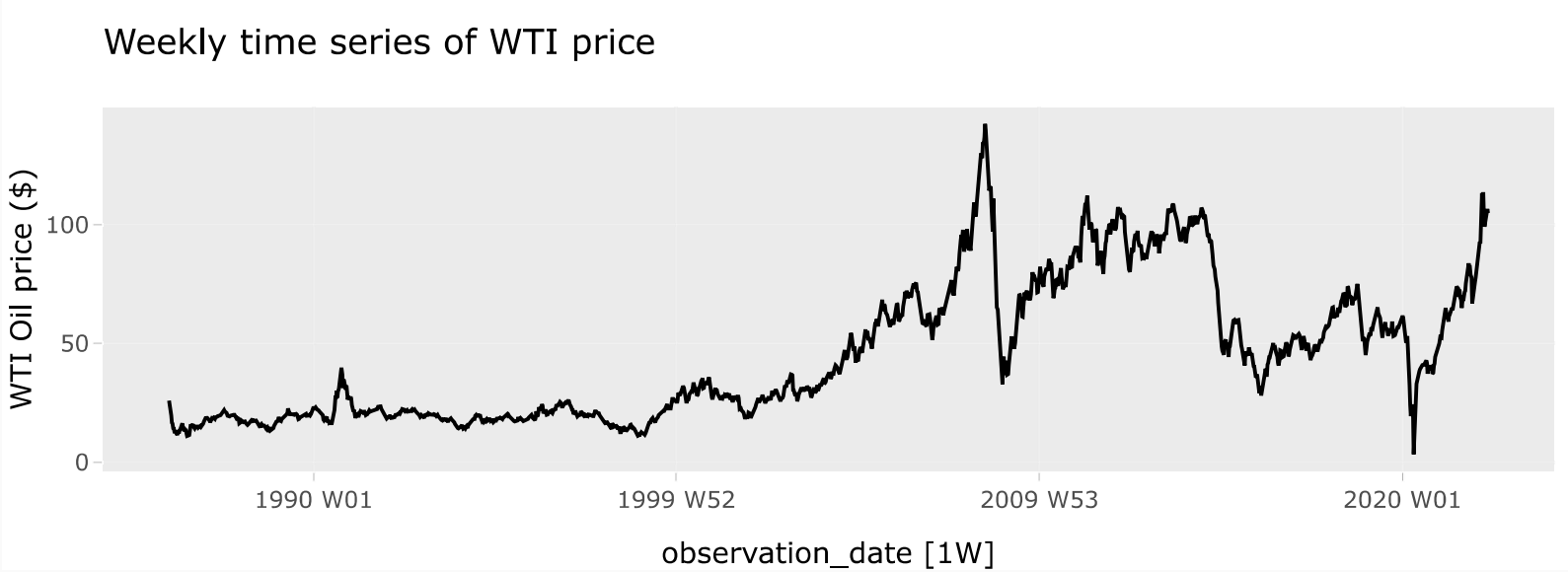
Several key nodes of the shocks:

- Gulf war at Iraq and Kuwait in 1990s
- The economic bubbles and financial crisis in 2000s (~2008)
- The excessive oil supply in 2014
- Covid pandemic in 2020
- Currently, the price recovery due to the lockdown lift and the Ukraine-Russia war



data updated: 2022-05-14

STL Component

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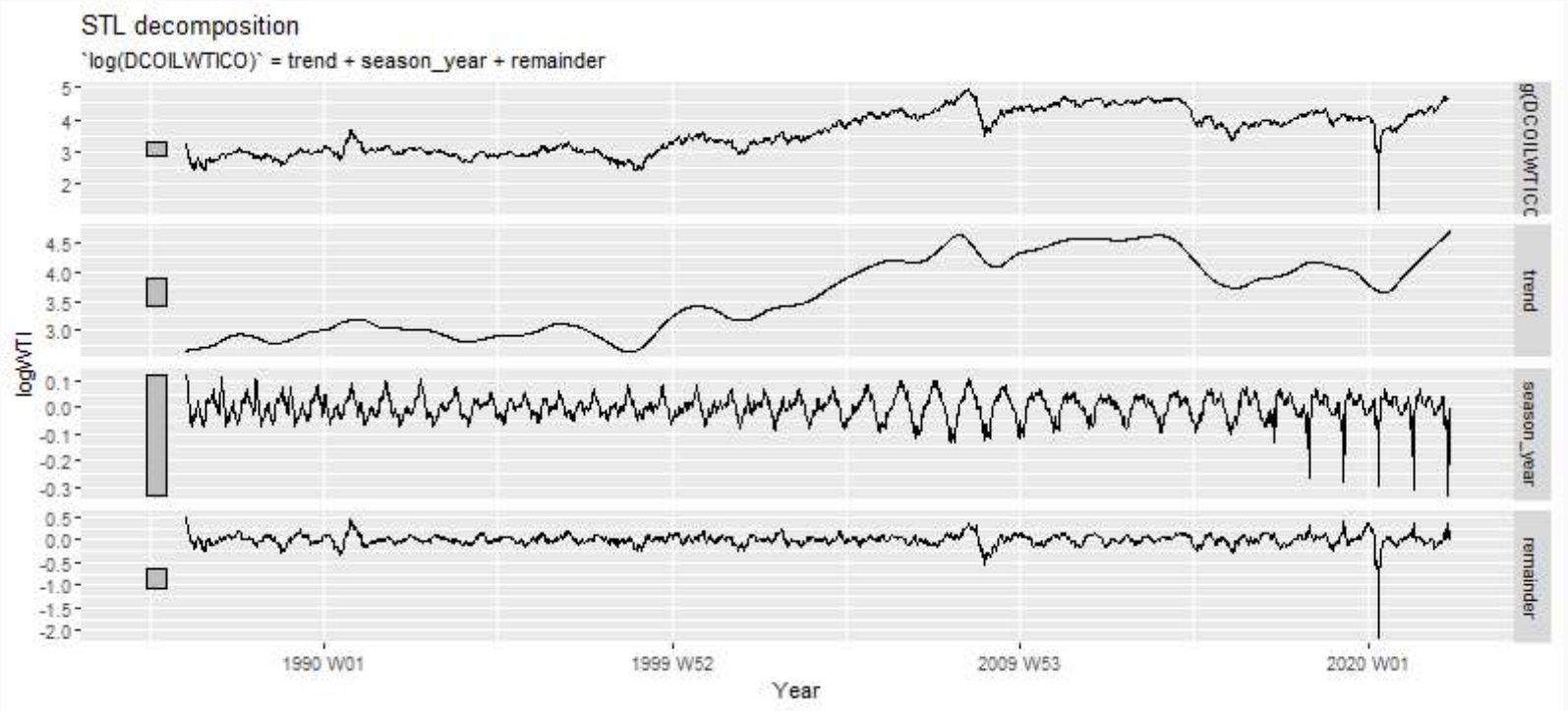

- Trend: It looked stable before 1999 then there had been an upward trend until 2009. After 2009, it is stable again
- Seasonality: There is a yearly seasonality but it has a small impact on this time series
- Remainder: Normally it is volatile around the range of 0.5 to -0.5 but we see the sharp drop in 2020

Building Model | without regressors

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model	model_desc
arima310	<ARIMA(3,1,0)(1,0,0)[52]>
arima013	<ARIMA(0,1,3)(1,0,0)[52]>
stepwise	<ARIMA(2,1,3)(1,0,0)[52]>
search	<ARIMA(2,1,3)(1,0,0)[52]>

> Select 1 differencing in ARIMA model and try serveral possibilities.

- Here, we can observe auto ARIMA models (stepwise and search) have smaller AICc

Show 2 entries

Accuracy of Models

	.model	sigma2	log_lik	AIC	AICc	BIC
1	stepwise	0.00	2,345.75	-4,677.51	-4,677.45	-4,638.68
2	search	0.00	2,345.75	-4,677.51	-4,677.45	-4,638.68

Showing 1 to 2 of 4 entries

Previous 1 2 Next

Building Model | without regressors

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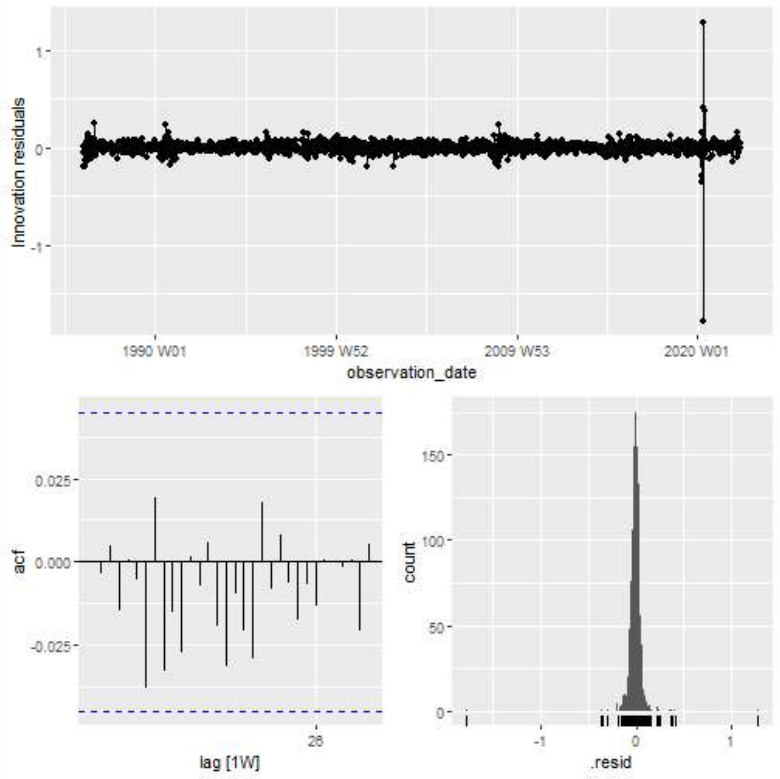
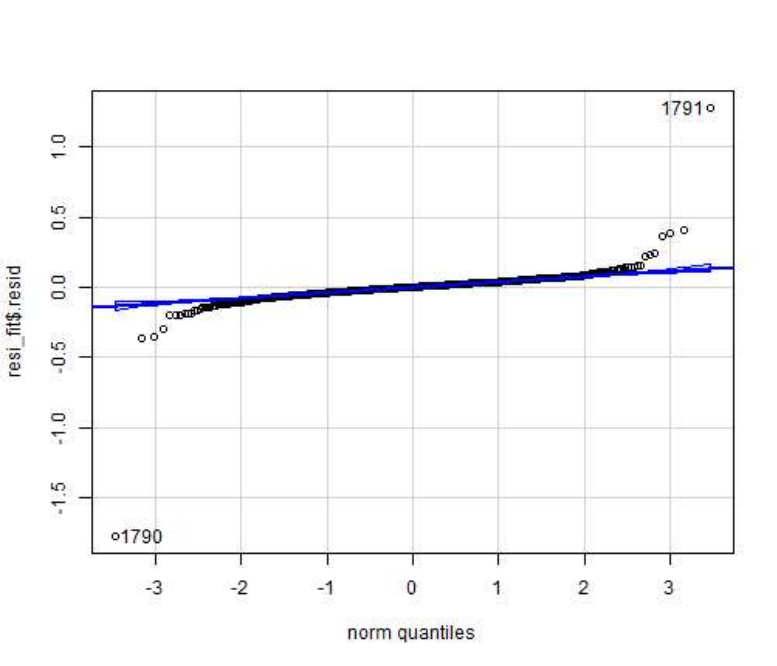
> Selected model: auto ARIMA model






```
## [1] 1790 1791
```

- Overall, the residual examination returns good performance. There is no autocorrelation and it is fat-tailed distribution with two large outliers from covid pandemic.

Building Model | without regressors

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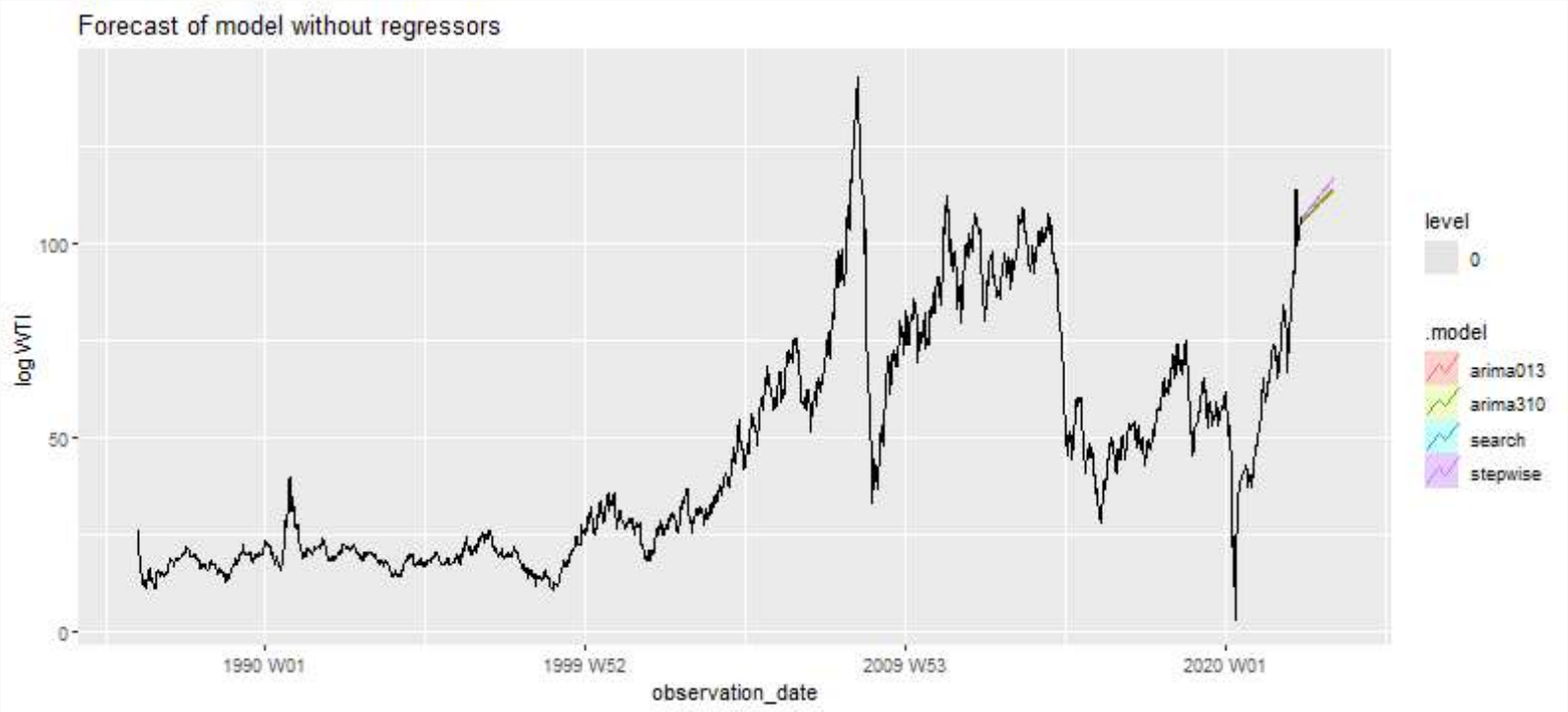
Forecasting



- Every model returns similar results
- The price will increase next year.

Building Model | with regressors

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> Auto ARIMA + regressors

```
fit_reg ← model(gdpcpi,
                mod_gdpcpi = ARIMA(log(DCOILWTICO) ~ logGDP + logCPI),
                mod_gdp    = ARIMA(log(DCOILWTICO) ~ logGDP),
                mod_cpi    = ARIMA(log(DCOILWTICO) ~ logCPI))
```

Models description

model	model_desc
mod_gdpcpi	<LM w/ ARIMA(2,1,1)(1,0,0)[52] errors>
mod_gdp	<LM w/ ARIMA(2,1,2)(1,0,0)[52] errors>
mod_cpi	<LM w/ ARIMA(2,1,2)(1,0,0)[52] errors>

Building Model | with regressors

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Show 3 entries

Accuracy of models with regressors

	.model	sigma2	log_lik	AIC	AICc	BIC
1	mod_gdpcpi	0.00	2,387.77	-4,759.53	-4,759.45	-4,715.23
2	mod_cpi	0.00	2,376.96	-4,737.91	-4,737.84	-4,693.61
3	mod_gdp	0.00	2,337.87	-4,659.73	-4,659.66	-4,615.44

Showing 1 to 3 of 3 entries

Previous 1 Next

Model with two regressors

mod_gdpcpi	loggdp	logcpi
coef	5.91	16.69
s.e	1.09	1.51

- Residuals are similar to the auto ARIMA model
- GDP and CPI are positive correlated with oil price
- Auto ARIMA plus two regressors is the best model

Scenario Analysis

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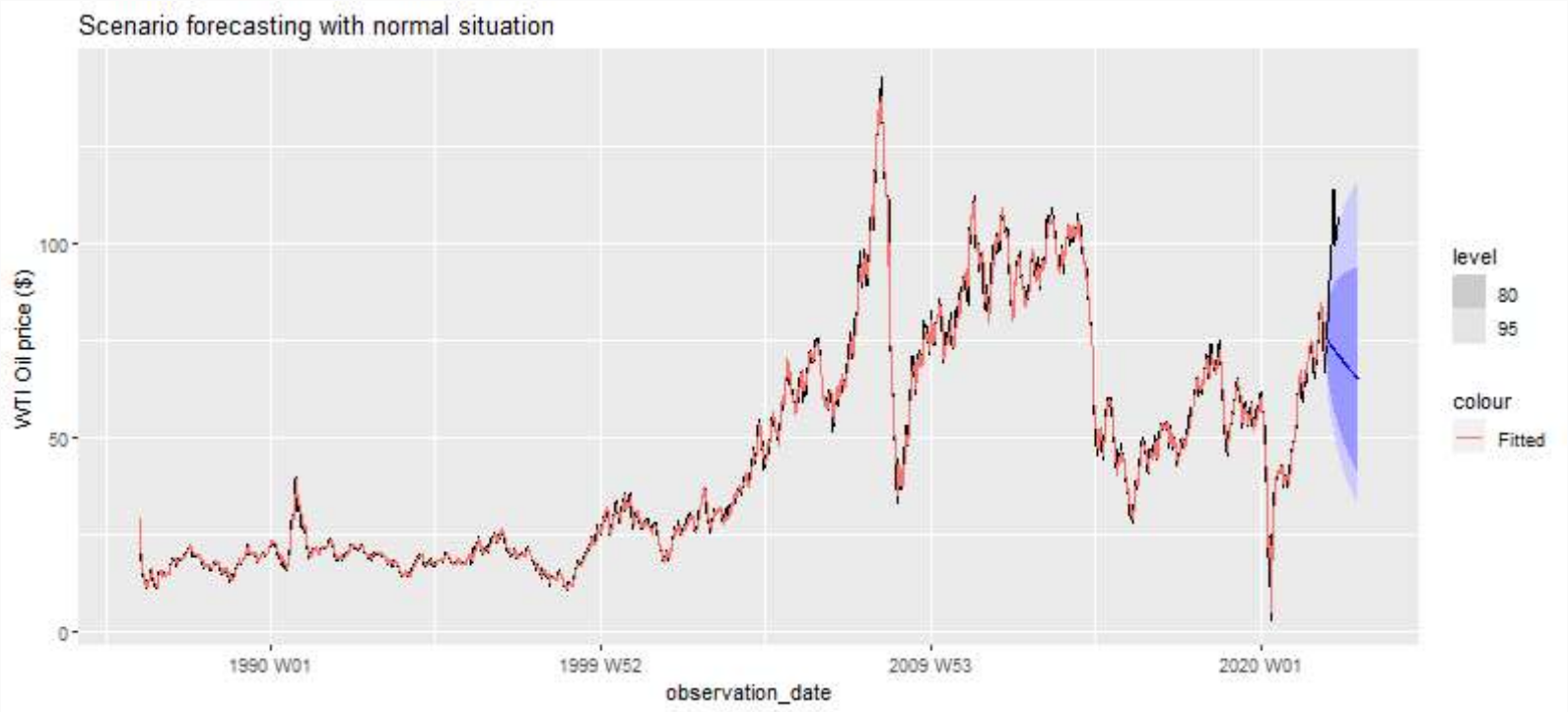
> Scenario 1: forecasting with normal situation (CPI+2%, US GDP +2.5%)



- GDP: Historical US GDP before Covid is around 2.5%
- CPI: The inflation is in line with the target from the Federal Reserves at 2%
  Data from the world bank

Scenario Analysis

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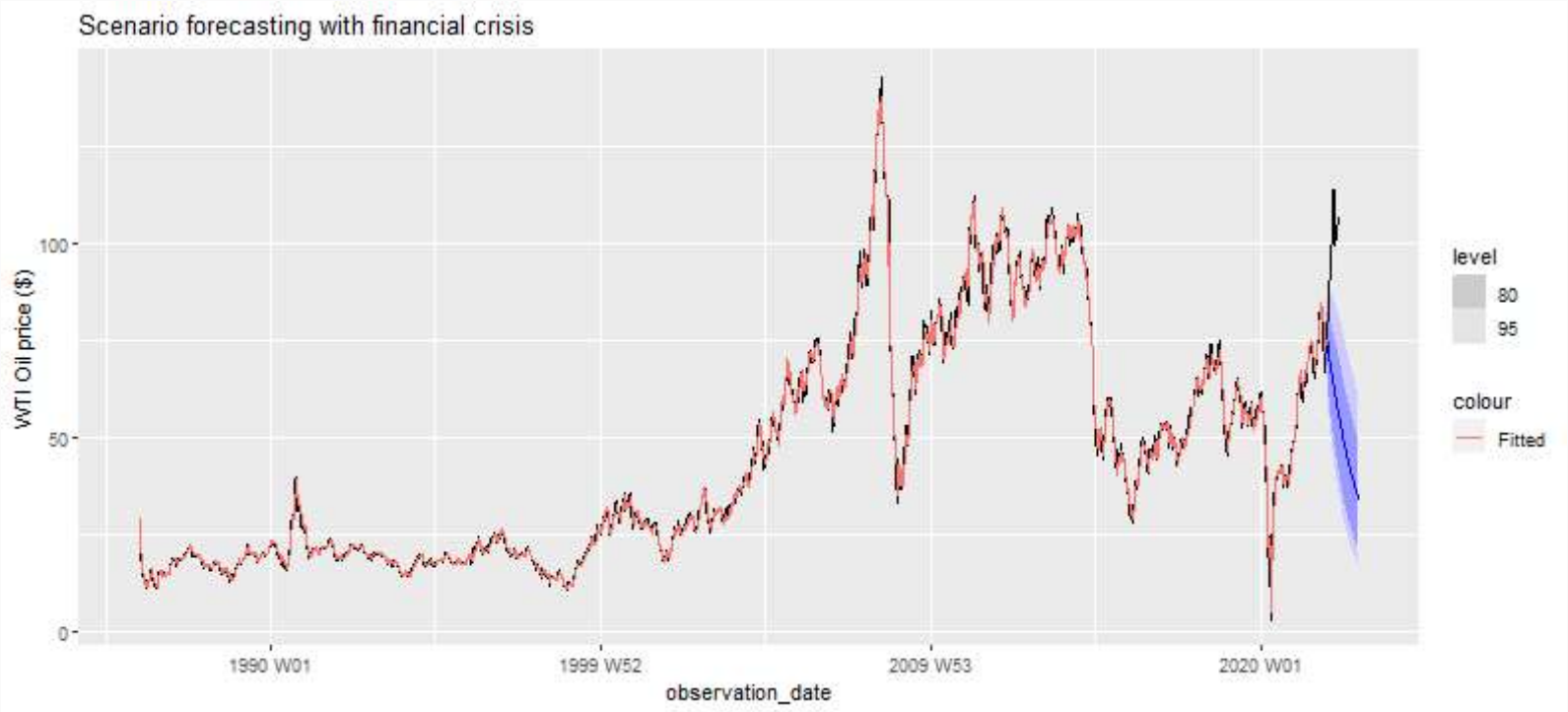
> Scenario 2: forecasting with financial crisis (CPI+0%, US GDP-3%)



- GDP: Historical US GDP changes in 2008 and 2020 were -2.5% and -3.4%, respectively
- CPI: Assuming inflation stalls (CPI is unchanged)

Scenario Analysis

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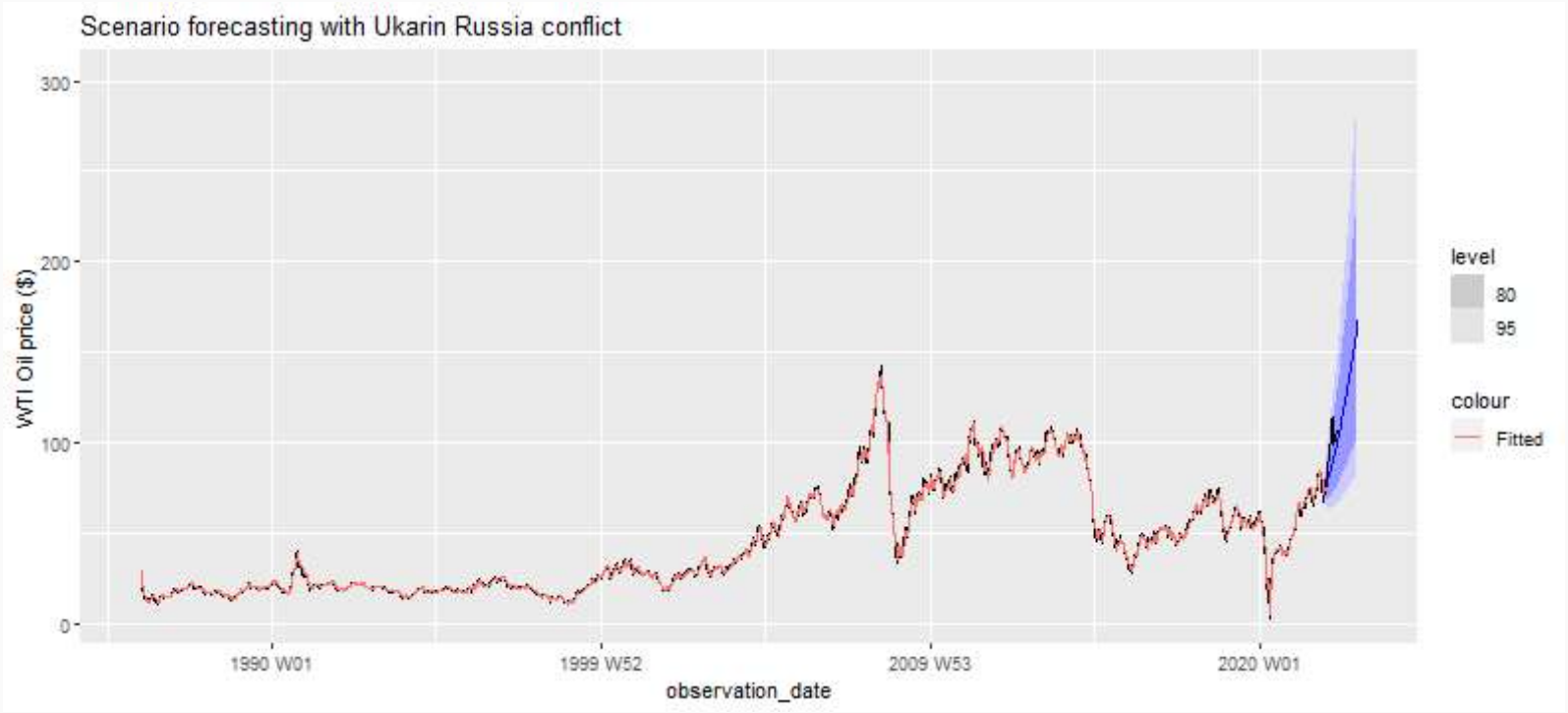
> Scenario 3: forecasting with Ukarin Russia conflict (CPI+8%, limited impact on US GDP)



- GDP: War between Ukarin and Russia has limited impact on the US economy
- CPI: Data from United States Department of Labor

Q & A

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Thank you for your attention!