CRAM1
Problem Set #4

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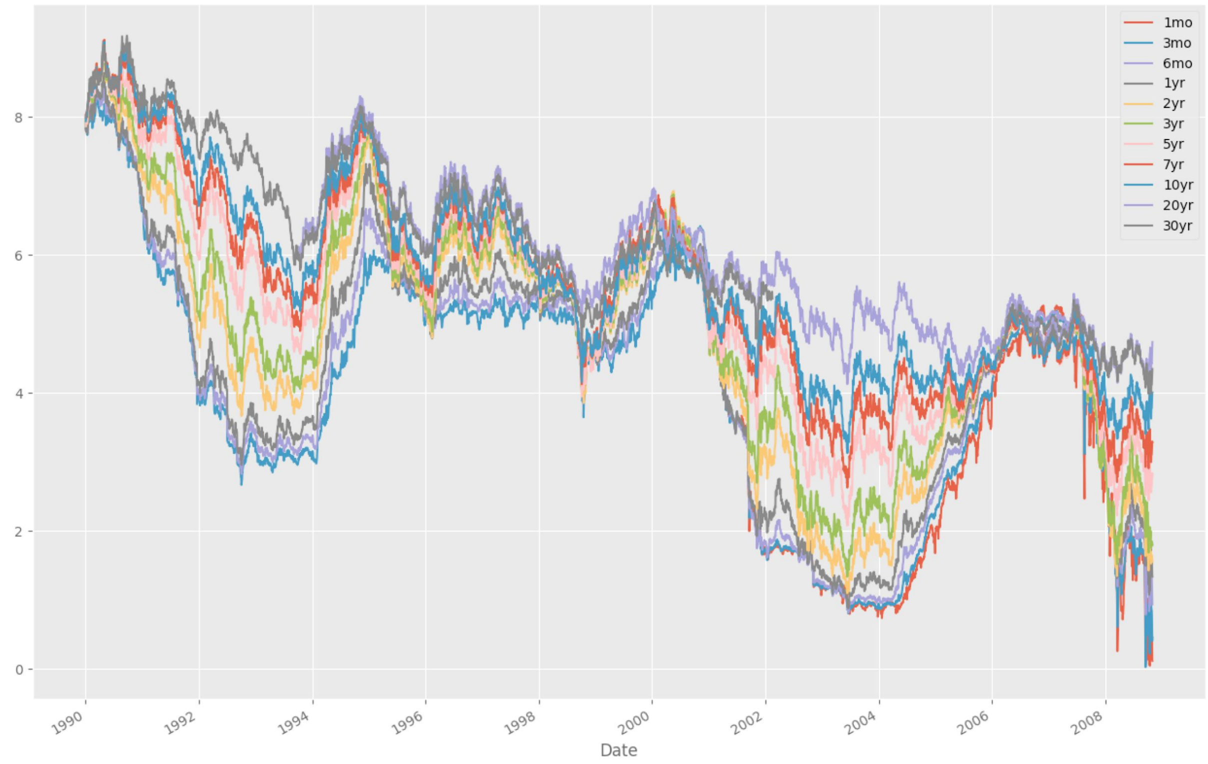
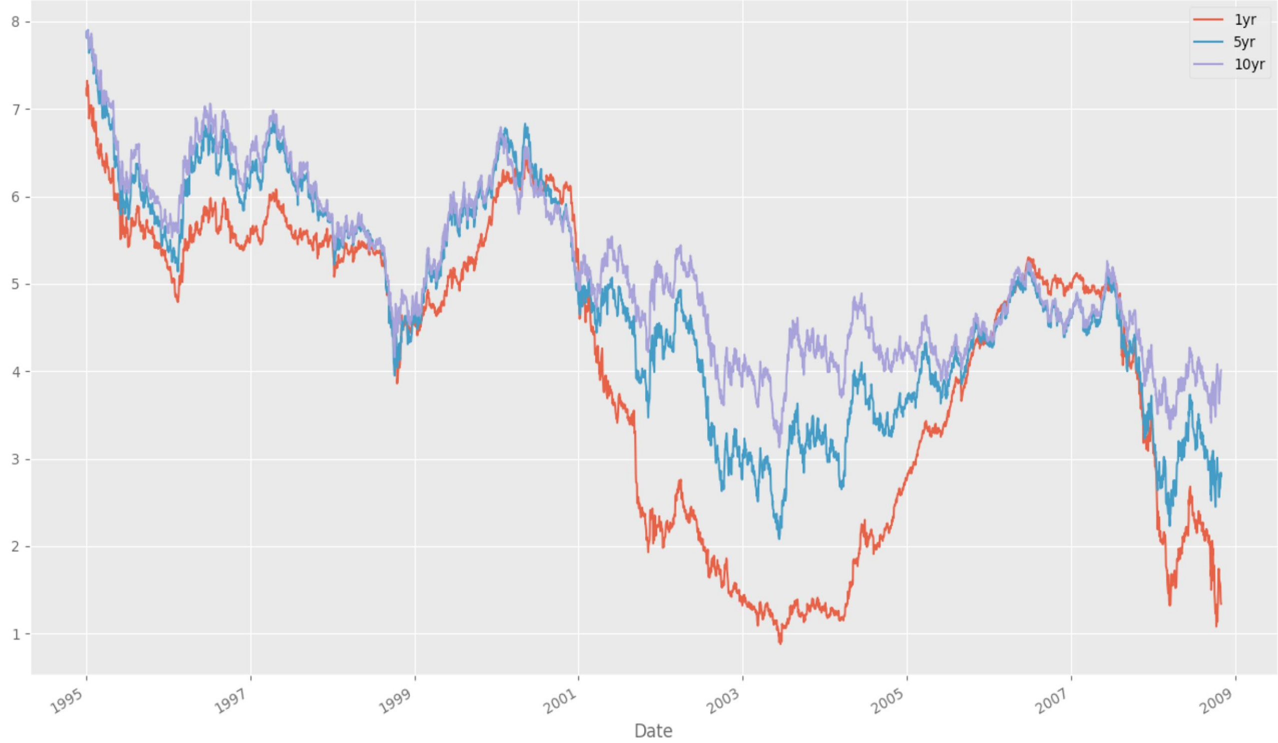
Q1a: Treasury Yields



Observation:

The higher the maturity, the higher the vol.

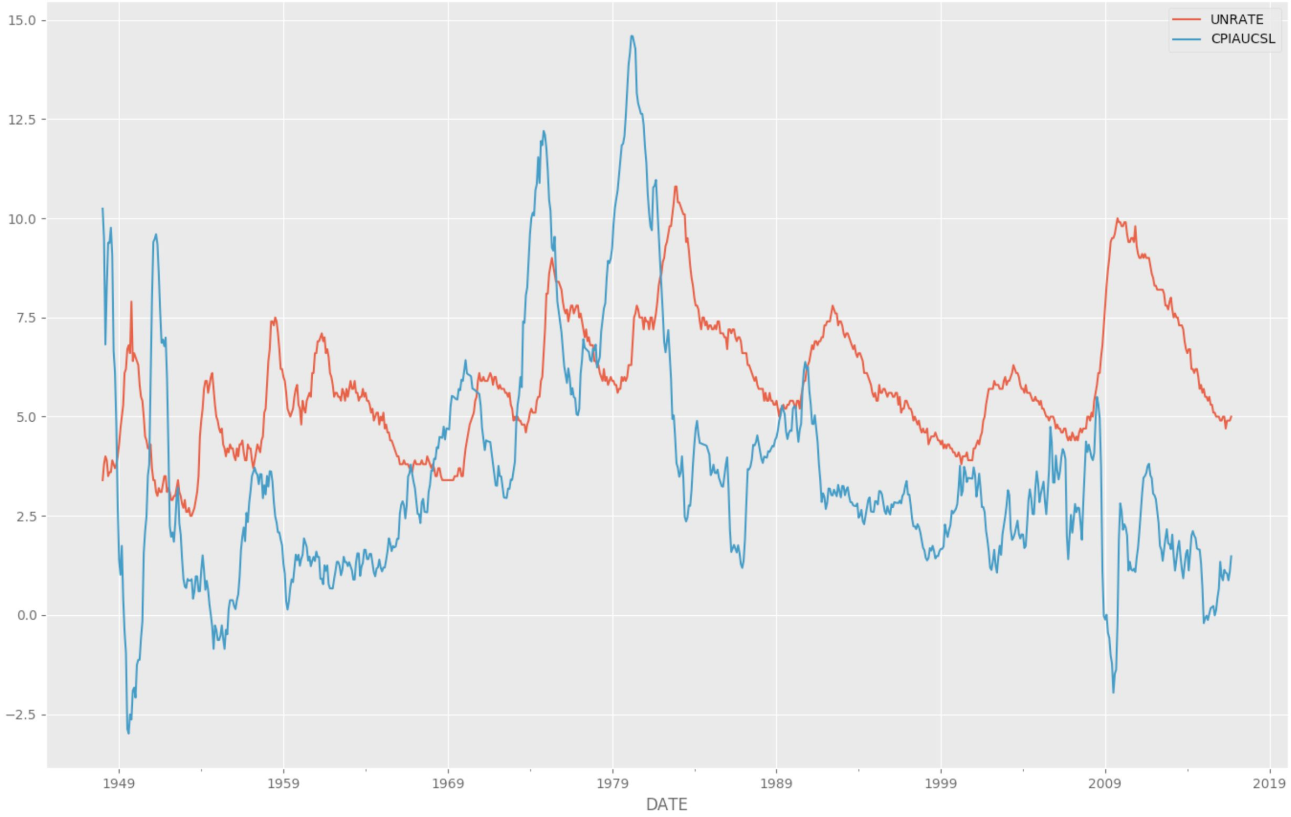
Q1a: Treasury Yields



Observation:

The higher the maturity, the higher the vol.

Q1b: Macroeconomic Data



1949, 1980s: recession in the US (un. rate increase, infl. rate decrease)

2009: global financial crisis

Question 1c: Class VAR

```python
def estimate_VAR(self, summary=True):

  # DONE: Run OLS estimation row by row
  for i in range(self.i):
    results = sm.OLS(self.Y[:,i],self.X).fit()
    betas = results.params
    tstats = results.tvalues
    adj_rsqr = results.rsquared_adj
    epsilon = results.wresid

    # Set object variables
    self.betas[i, :] = betas.reshape(self.nvar, )
    self.tstats[i, :] = tstats.reshape(self.nvar, )
    self.resid[:, i] = epsilon.reshape(self.nobs, )
    self.adj_rsqr[i] = adj_rsqr

  # DONE: Calculate covariance (correlation) matrix of the error terms
  self.Cov = np.cov(np.transpose(self.resid))
  self.Corr = np.corrcoef(np.transpose(self.resid))
```

Question 1d: VAR Estimation (p=1, k=5)

```
data_all['UNRATE_dm'] = data_all['UNRATE'] - np.mean(data_all['UNRATE'])
data_all['CPIAUCSL_dm'] = data_all['CPIAUCSL'] - np.mean(data_all['CPIAUCSL'])
data_all['1yr_dm'] =  data_all['1yr'] - np.mean(data_all['1yr'])
data_all['5yr_dm'] = data_all['5yr'] - np.mean(data_all['5yr'])
data_all['10yr_dm'] = data_all['10yr'] - np.mean(data_all['10yr'])
```

Parameters and statistic after OLS:

```
Betas:          [ 0.916  0.032 -0.026 -0.103  0.13 ]
t-stats:        [ 33.24   2.58  -0.81  -0.92   1.29]

Betas:          [-0.056  0.9    0.051 -0.161  0.098]
t-stats:        [ -0.73  25.59   0.57  -0.52   0.35]

Betas:          [ 0.032 -0.018  0.88   0.44  -0.383]
t-stats:        [  0.63  -0.76  14.73   2.12  -2.05]

Betas:          [ 0.007 -0.031  0.054  0.895  0.001]
t-stats:        [ 0.12 -1.08  0.74  3.57  0.   ]

Betas:          [ 0.034 -0.022  0.035  0.029  0.865]
t-stats:        [ 0.62 -0.88  0.55  0.13  4.33]
```

Observation:

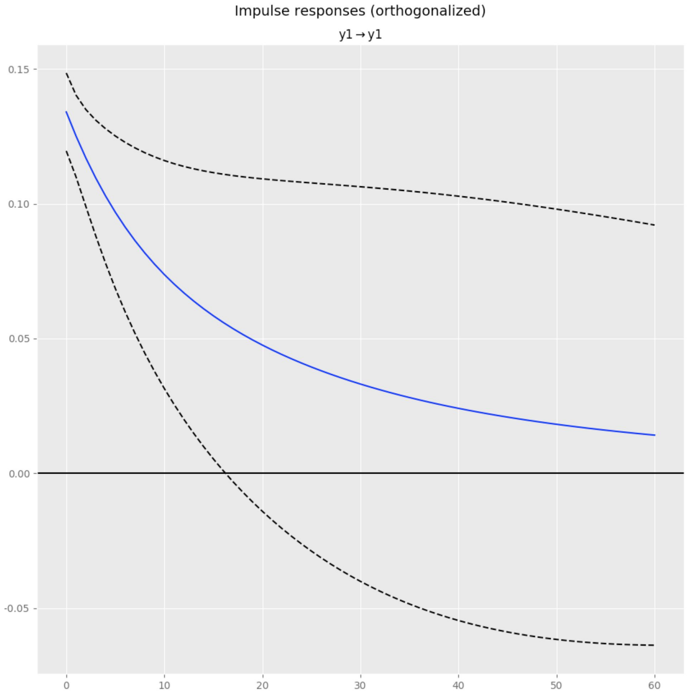
- Significant relationship between individual beta and endogenous variable (i.e. y1, y2 etc.) for each "OLS row" (also reflected in p-values)
- Economic interpretation:
  - un. rate and infl. rate co-move more with exogeneous data than t-bills
  - un. rate is negatively correlated with infl. rate
  - t-bills are negatively correlated with infl. rate
- Use betas in a (V)AR(p) process for forecasting

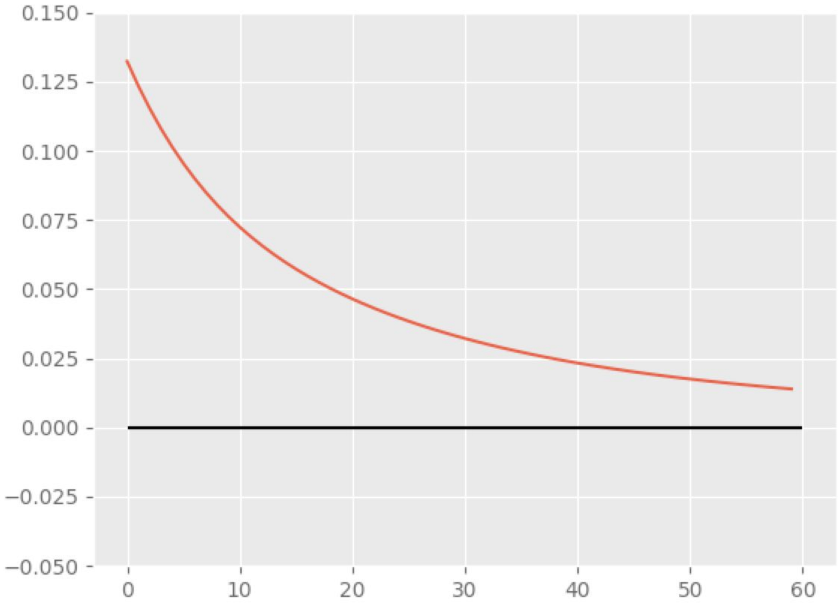
Question 1d: VAR Estimation (p=1, k=5)

Corr. of residuals

	y1	y2	y3	y4	y5
y1	1.000000	0.046431	-0.101398	-0.073767	-0.034571
y2	0.046431	1.000000	0.070626	0.044094	0.045683
y3	-0.101398	0.070626	1.000000	0.788085	0.650412
y4	-0.073767	0.044094	0.788085	1.000000	0.955932
y5	-0.034571	0.045683	0.650412	0.955932	1.000000

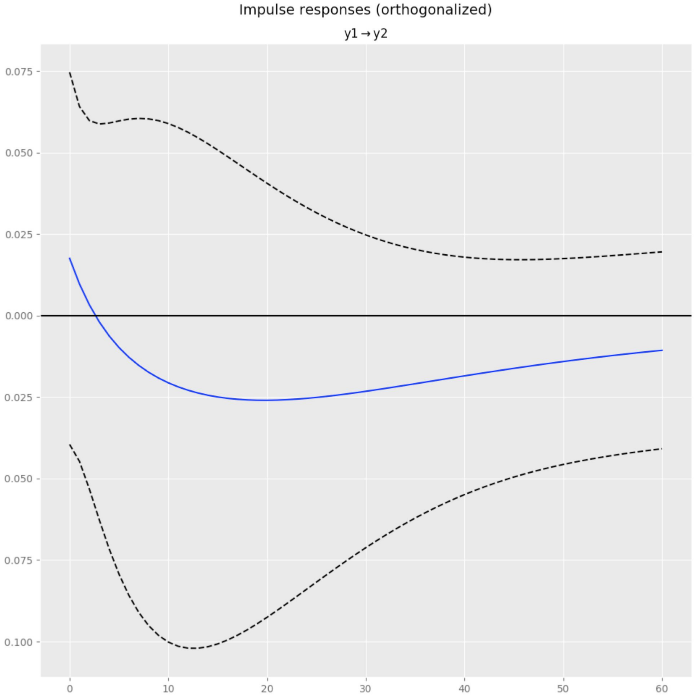
Question 1f: Economic Analysis





-> Unemployment affects unemployment, assumption: confidence interval does not consistently cover 0-mean

Question 1f: Economic Analysis



(modified Phillips-curve: unemployment rate is negatively correlated with inflation rate)

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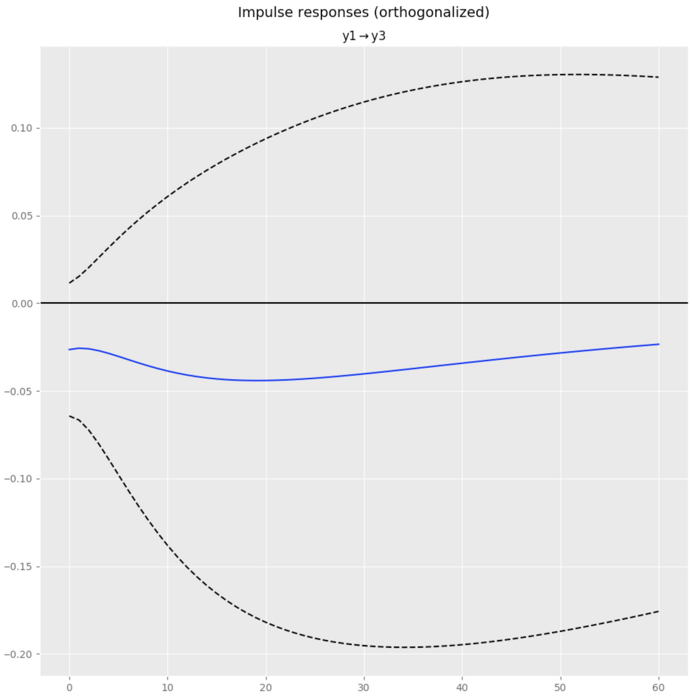

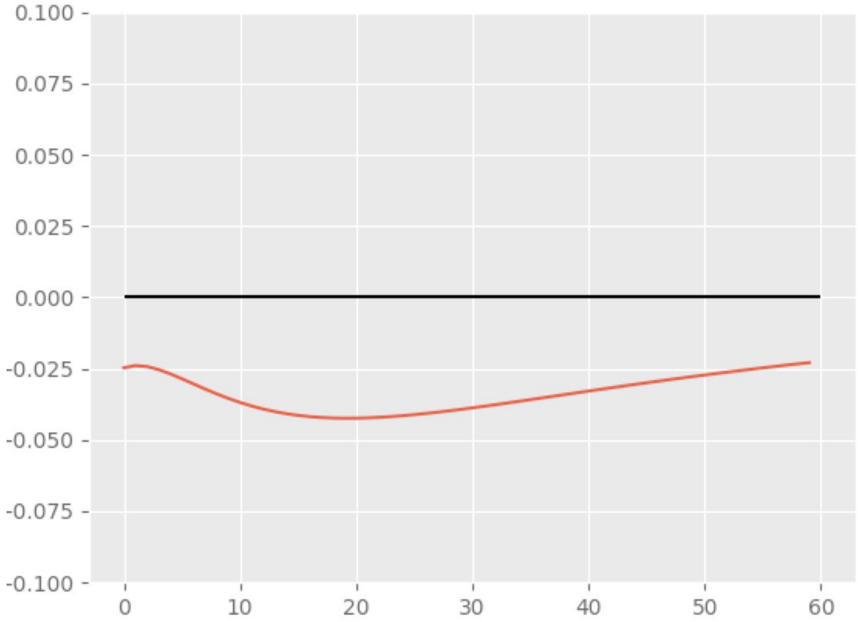

-> shock to unemployment rate does hardly/not affect short-term yield

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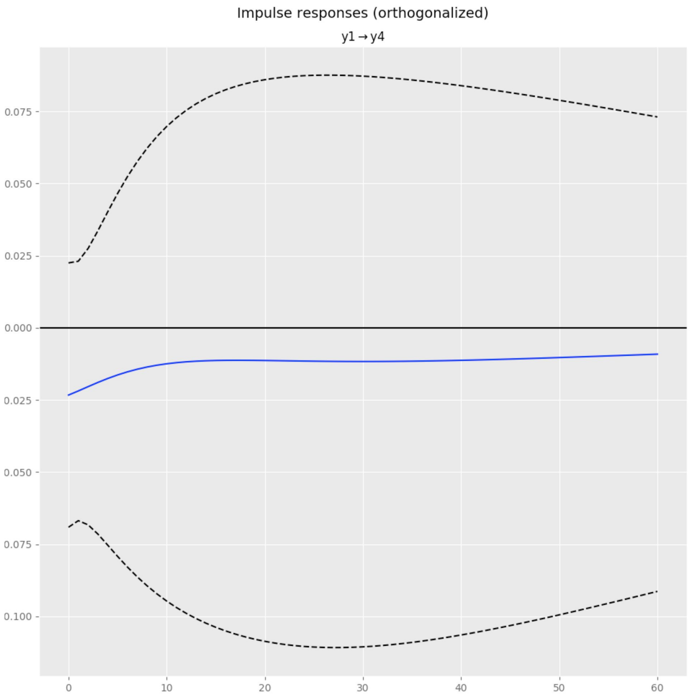
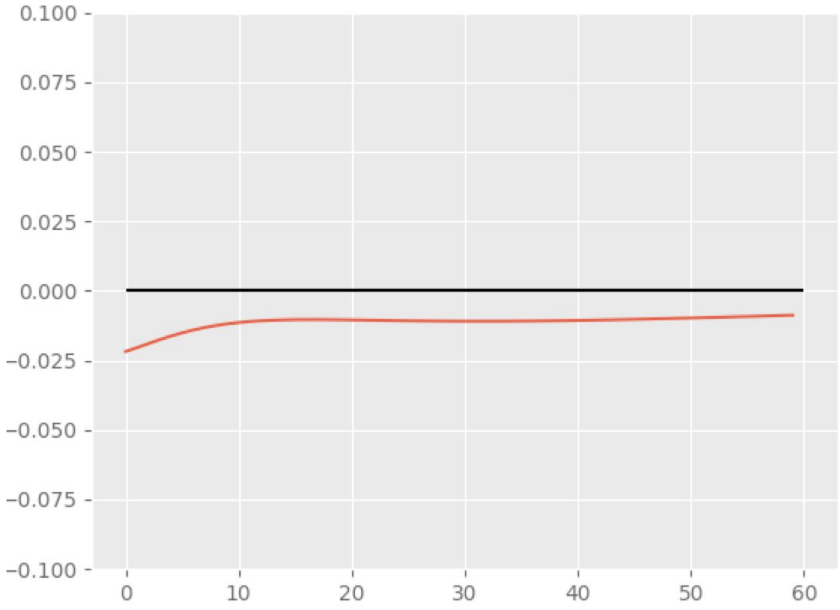
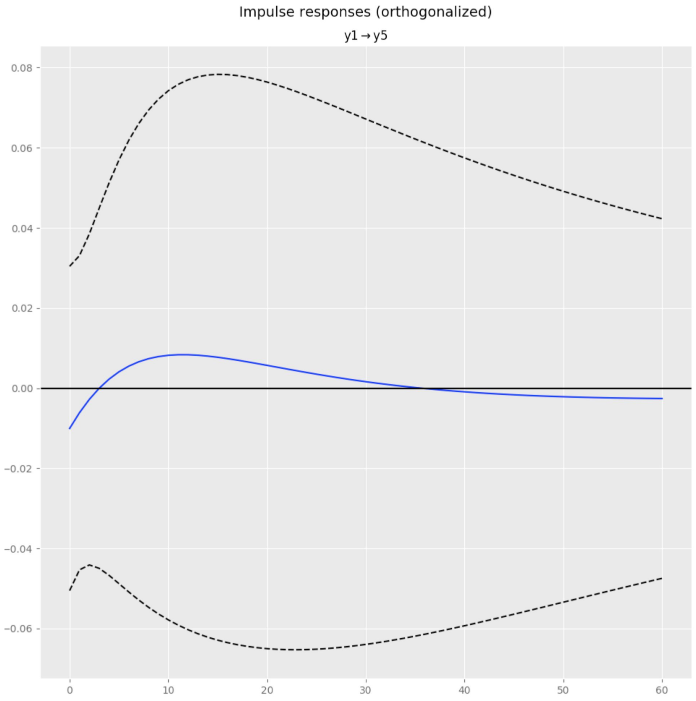
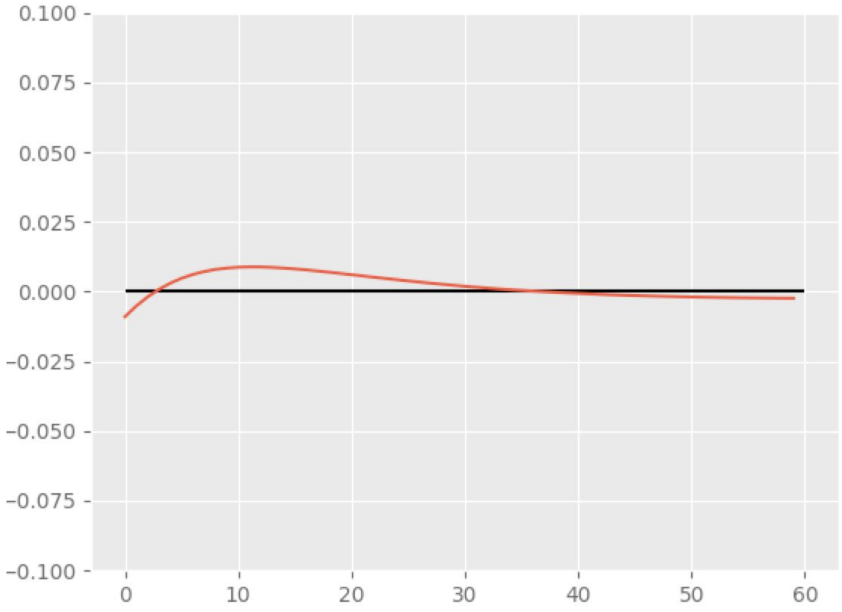




-> shock to unemployment rate does hardly/not affect **medium-term** yield

Question 1f: Economic Analysis





-> shock to unemployment rate does hardly/not affect **long-term** yield