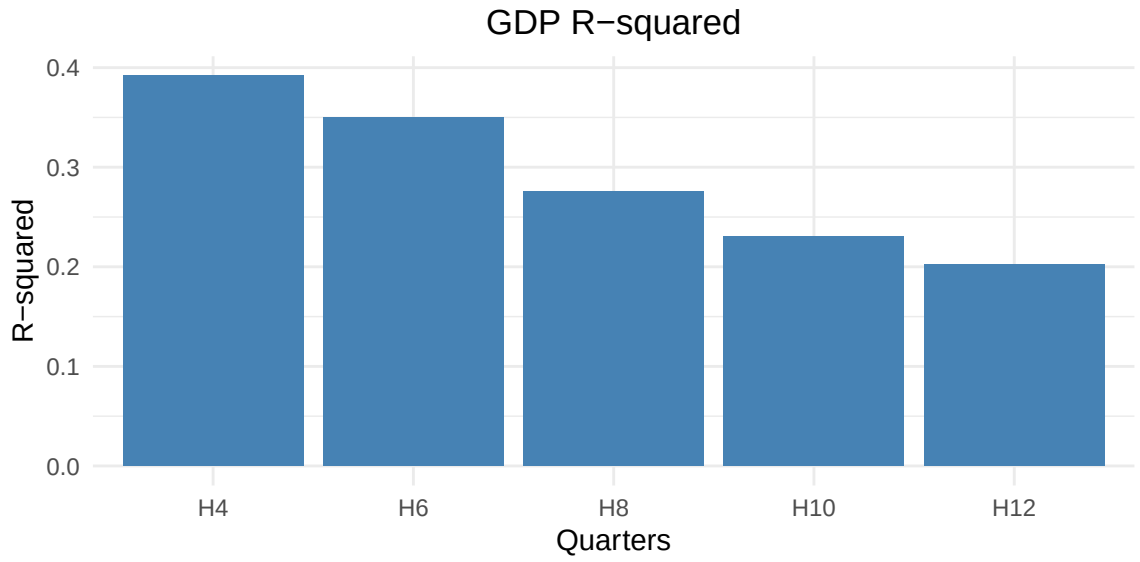
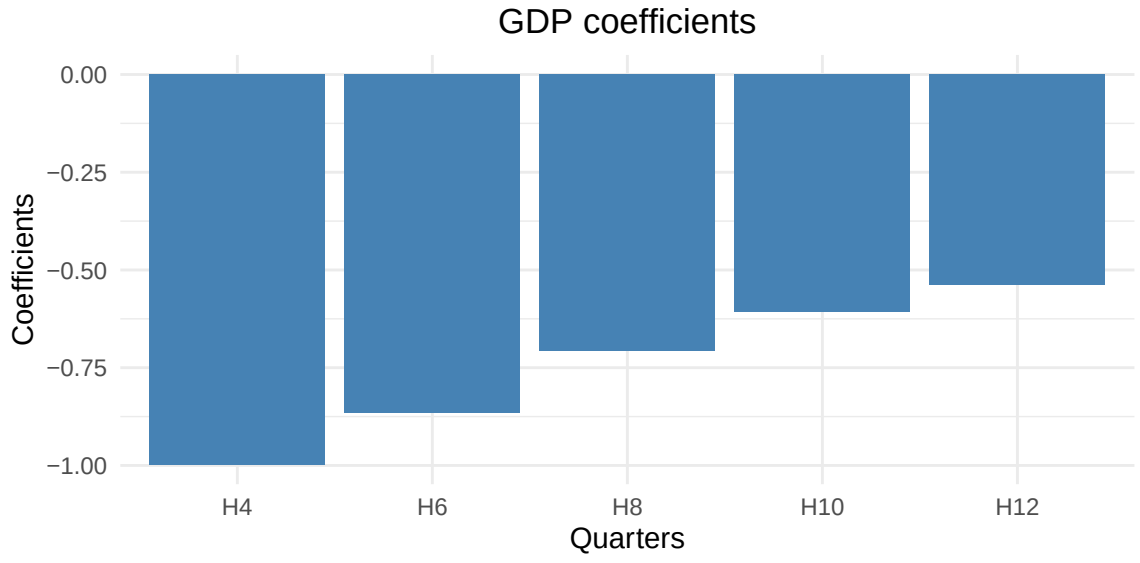
Appendices

12.11-2020

1 Appendices

1.1 Appendix A





1.2 Appendix B

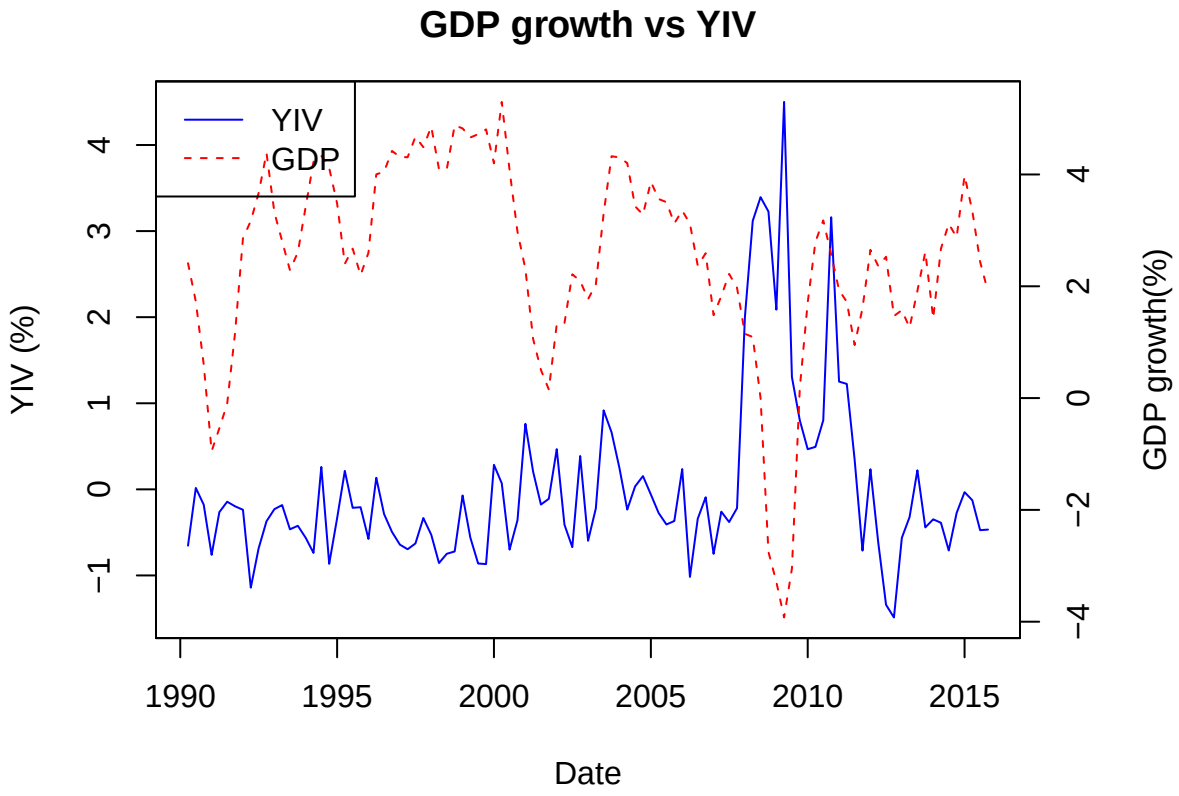


Figure 1.1: GDP Growth(%) vs 5-year Treasury Implied Volatility

1.3 Appendix C

Notes: This table includes summary statistics for main variables used in our research. Statistics include mean, standard deviation„ min, 1st quartile, median, 3rd quartile, max & number of valid data points. In Panel A, YIV data is summarized. In Panel B, we have listed the main dependent variables which are used for predictions. GDP denotes the year-on-year growth rate(quarterly data), CON denotes YOY consumption growth(monthly data), EMP describes YOY growth rate for non-farm payroll and lastly IND stands for Industrial production YOY growth (monthly data). In Panel C, different control variables are listed:

Table 1.1: Summary Statistics

Variable	Mean	Std.Dev	Min	Q1	Median	Q3	Max
Panel A: YIV & GDP							
YIV	3.34	1.31	1.39	2.60	3.00	3.62	9.21
GDP	2.50	1.78	-3.92	1.71	2.61	3.98	5.30
Panel B: Control Variables							
AAA	6.22	1.52	3.46	5.20	6.00	7.43	9.40
DBAA	7.18	1.47	4.50	6.18	7.25	8.22	10.61
baa_aaa	0.96	0.40	0.56	0.70	0.89	1.06	3.00
VIX	19.81	7.35	11.03	14.17	17.56	24.01	58.74
spy_logreturn	6.88	17.42	-53.43	1.02	10.92	18.24	34.95
housng	3.18	51.49	-151.80	-16.80	14.10	36.10	117.70
gz_spr	1.98	1.23	0.79	1.09	1.64	2.59	7.66
TRM1003	1.86	1.13	-0.63	0.84	2.03	2.74	3.61
TRM1006	1.73	1.14	-0.63	0.73	1.88	2.61	3.53
TRM1012	1.59	1.06	-0.36	0.66	1.74	2.52	3.35
TRM0503	1.28	0.83	-0.64	0.61	1.38	1.96	2.88
TRM0506	1.14	0.81	-0.64	0.53	1.25	1.75	2.72
SRT03M	-0.29	1.36	-4.25	-0.77	-0.06	0.12	2.58

Note:
The variables are shown prior to the standardization process.

1.4 Appendix D.

Notes: This table depicts the output of regression with YIV as independent variable. The equation for the regression is following:

$$\sum_{j=1}^{j=H} log(1 + GDP_{i,t+j})/H = \alpha_H + \beta_H \sigma_{IV,t} + \varepsilon_{t+H} \quad (1)$$

Table 1.2: Regression output

	H4	H6	H8	H10	H12
YIV_estimate	-1.00	-0.87	-0.71	-0.61	-0.54
YIV_std.error	0.24	0.22	0.18	0.14	0.13
YIV_p.value	0.00	0.00	0.00	0.00	0.00
r.squared	0.39	0.35	0.28	0.23	0.20
adj.r.squared	0.39	0.34	0.27	0.22	0.19

Note:

*** - p<0.01, ** - p<0.05, * - p<0.1. Reported standard error is adjusted for heteroskedasticity

1.5 Appendix E.

Notes: YIV and dummy as independent variables. The equation for the regression is following:

$$\sum_{j=1}^{j=H} log(1 + GDP_{i,t+j})/H = \alpha_H + \beta_H \sigma_{IV,t} + Dummy + \varepsilon_{t+H} \quad (2)$$

Table 1.3: Regression with state-dependency

	H4	H6	H8	H10	H12
YIV_estimate	-0.54	-0.48	-0.41	-0.40	-0.38
YIV_std.error	0.14	0.13	0.10	0.10	0.10
YIV_p.value	0.00	0.00	0.00	0.00	0.00
dum_estimate	-2.72	-2.31	-1.75	-1.22	-0.93
dum_std.error	0.40	0.34	0.22	0.26	0.28
dum_p.value	0.00	0.00	0.00	0.00	0.00
r.squared	0.61	0.54	0.40	0.30	0.25
adj.r.squared	0.60	0.53	0.39	0.29	0.23

Note:

*** - p<0.01, ** - p<0.05, * - p<0.1. Reported standard error is adjusted for heteroskedasticity

```
##   Variables Tolerance      VIF
## 1       YIV 0.3696205 2.705477
## 2       dum 0.6153407 1.625116
## 3   YIV:dum 0.3169087 3.155483
```

1.6 Appendix F.

Notes: This table includes regression using YIV and GDP lags. The equation for the regression is following:

$$\sum_{j=1}^{j=H} log(1 + GDP_{i,t+j})/H = \alpha_H + \beta_H \sigma_{IV,t}^{INT} + lag[log(1 + GDP_{i,t+j})] + \varepsilon_{t+H} \quad (3)$$

Table 1.4: Regression with state-dependency

	H4	H6	H8	H10	H12
YIV_estimate	-0.62	-0.61	-0.49	-0.42	-0.38
YIV_std.error	0.20	0.21	0.17	0.12	0.12
YIV_p.value	0.00	0.01	0.00	0.00	0.00
lag1_estimate	0.86	0.59	0.48	0.45	0.40
lag1_std.error	0.10	0.11	0.11	0.12	0.13
lag1_p.value	0.00	0.00	0.00	0.00	0.00
lag2_estimate	-0.46	-0.31	-0.24	-0.25	-0.25
lag2_std.error	0.11	0.09	0.08	0.09	0.10
lag2_p.value	0.00	0.00	0.01	0.00	0.01
r.squared	0.65	0.51	0.40	0.34	0.28
adj.r.squared	0.64	0.50	0.38	0.32	0.26

Note:
*** - p<0.01, ** - p<0.05, * - p<0.1. Reported standard error is adjusted for heteroskedasticity

```
##   Variables Tolerance      VIF
## 1       YIV 0.7742275 1.291610
## 2      lag1 0.1883545 5.309137
## 3      lag2 0.2046618 4.886109
```

1.7 Appendix G.

Notes: This table includes regression using GDP lags and controls. The equation for the regression is following:

$$\sum_{j=1}^{j=H} log(1 + GDP_{i,t+j})/H = \alpha_H + \beta_H \sigma_{IV,t}^{INT} + lag[log(1 + GDP_{i,t+j})] + \varepsilon_{t+H} \quad (4)$$

Table 1.5: Regression with state-dependency

	H4	H6	H8	H10	H12
lag1_estimate	0.30	0.09	0.04	0.03	-0.04
lag1_std.error	0.22	0.24	0.23	0.20	0.18
lag1_p.value	0.19	0.73	0.88	0.87	0.81
lag2_estimate	0.06	0.22	0.30	0.29	0.30
lag2_std.error	0.15	0.16	0.16	0.15	0.15
lag2_p.value	0.71	0.17	0.06	0.06	0.05
DGS1_estimate	0.03	0.28	0.62	0.98	1.32
DGS1_std.error	0.42	0.49	0.50	0.50	0.48
DGS1_p.value	0.95	0.58	0.22	0.05	0.01
TRM1012_estimate	0.46	0.69	0.98	1.27	1.50
TRM1012_std.error	0.35	0.44	0.47	0.49	0.48
TRM1012_p.value	0.19	0.12	0.04	0.01	0.00
SRT03M_estimate	0.14	0.18	0.13	0.03	-0.05
SRT03M_std.error	0.24	0.32	0.31	0.27	0.23
SRT03M_p.value	0.56	0.58	0.69	0.90	0.83
baa_aaa_estimate	-0.09	0.12	0.21	0.09	-0.05
baa_aaa_std.error	0.18	0.26	0.26	0.24	0.21
baa_aaa_p.value	0.61	0.64	0.42	0.69	0.82
VIX_estimate	-0.11	-0.21	-0.19	-0.11	-0.10
VIX_std.error	0.18	0.23	0.22	0.20	0.19
VIX_p.value	0.54	0.36	0.39	0.57	0.61
housng_estimate	0.04	0.13	0.27	0.32	0.24
housng_std.error	0.12	0.13	0.15	0.16	0.13
housng_p.value	0.77	0.32	0.09	0.05	0.07
gz_spr_estimate	-0.77	-0.97	-0.93	-0.66	-0.40
gz_spr_std.error	0.25	0.25	0.31	0.38	0.39
gz_spr_p.value	0.00	0.00	0.00	0.09	0.32
spy_logreturn_estimate	0.02	0.01	0.00	0.00	0.01
spy_logreturn_std.error	0.02	0.02	0.02	0.02	0.02
spy_logreturn_p.value	0.23	0.61	0.87	0.86	0.72
r.squared	0.80	0.69	0.64	0.64	0.65

adj.r.squared	0.77	0.63	0.58	0.58	0.59

Note:
*** - p<0.01, ** - p<0.05, * - p<0.1. Reported standard error is adjusted for heteroskedasticity

```
##        Variables  Tolerance       VIF
## 1           lag1 0.08283638 12.071991
## 2           lag2 0.09082178 11.010575
## 3           DGS1 0.15540445  6.434822
## 4        TRM1012 0.18002094  5.554909
## 5         SRT03M 0.53884059  1.855836
## 6        baa_aaa 0.14625828  6.837220
## 7            VIX 0.69567251  1.437458
## 8         housng 0.71091598  1.406636
## 9         gz_spr 0.10506863  9.517589
## 10 spy_logreturn 0.18001199  5.555185
```

1.8 Appendix H.

Notes: YIV, dummy, GDP lags and controls as independent variables. The equation for the regression is following:

$$\sum_{j=1}^{j=H} log(1+GDP_{i,t+j})/H = \alpha_H + \beta_H \sigma_{IV,t}^{INT} + lag[log(1+GDP_{i,t+j})] + \varepsilon_{t+H} \qquad (5)$$

Table 1.6: Regression with state-dependency

	H4	H6	H8	H10	H12
YIV_estimate	-0.48	-0.58	-0.47	-0.36	-0.25
YIV_std.error	0.19	0.22	0.19	0.14	0.14
YIV_p.value	0.01	0.01	0.02	0.01	0.07
dum_estimate	-1.40	-1.32	-1.26	-0.98	-0.95
dum_std.error	0.54	0.74	0.71	0.56	0.49
dum_p.value	0.01	0.08	0.08	0.09	0.06
lag1_estimate	0.16	-0.06	-0.09	-0.07	-0.13
lag1_std.error	0.13	0.15	0.14	0.14	0.13
lag1_p.value	0.23	0.66	0.52	0.62	0.32
lag2_estimate	0.17	0.33	0.40	0.37	0.37
lag2_std.error	0.12	0.12	0.12	0.12	0.13
lag2_p.value	0.15	0.01	0.00	0.00	0.01
DGS1_estimate	0.19	0.45	0.77	1.10	1.42
DGS1_std.error	0.33	0.39	0.41	0.45	0.45
DGS1_p.value	0.58	0.26	0.06	0.02	0.00
TRM1012_estimate	0.58	0.83	1.10	1.36	1.56
TRM1012_std.error	0.27	0.36	0.41	0.47	0.46
TRM1012_p.value	0.04	0.03	0.01	0.01	0.00
SRT03M_estimate	-0.08	-0.04	-0.08	-0.12	-0.20
SRT03M_std.error	0.18	0.27	0.28	0.26	0.23
SRT03M_p.value	0.65	0.88	0.79	0.63	0.39
baa_aaa_estimate	0.22	0.48	0.51	0.33	0.12
baa_aaa_std.error	0.17	0.23	0.24	0.23	0.21
baa_aaa_p.value	0.22	0.04	0.04	0.16	0.57
VIX_estimate	0.09	0.01	0.00	0.03	0.02
VIX_std.error	0.13	0.16	0.16	0.16	0.17
VIX_p.value	0.49	0.97	0.98	0.83	0.89
housng_estimate	0.12	0.23	0.35	0.38	0.29
housng_std.error	0.10	0.15	0.19	0.19	0.16
housng_p.value	0.23	0.13	0.07	0.05	0.07
gz_spr_estimate	-0.52	-0.70	-0.70	-0.48	-0.25

gz_spr_std.error	0.27	0.26	0.30	0.37	0.39
gz_spr_p.value	0.06	0.01	0.02	0.20	0.52
spy_logreturn_estimate	0.02	0.02	0.01	0.01	0.01
spy_logreturn_std.error	0.01	0.01	0.01	0.01	0.01
spy_logreturn_p.value	0.01	0.10	0.45	0.57	0.54
r.squared	0.88	0.80	0.73	0.71	0.70
adj.r.squared	0.86	0.75	0.67	0.64	0.63

Note:

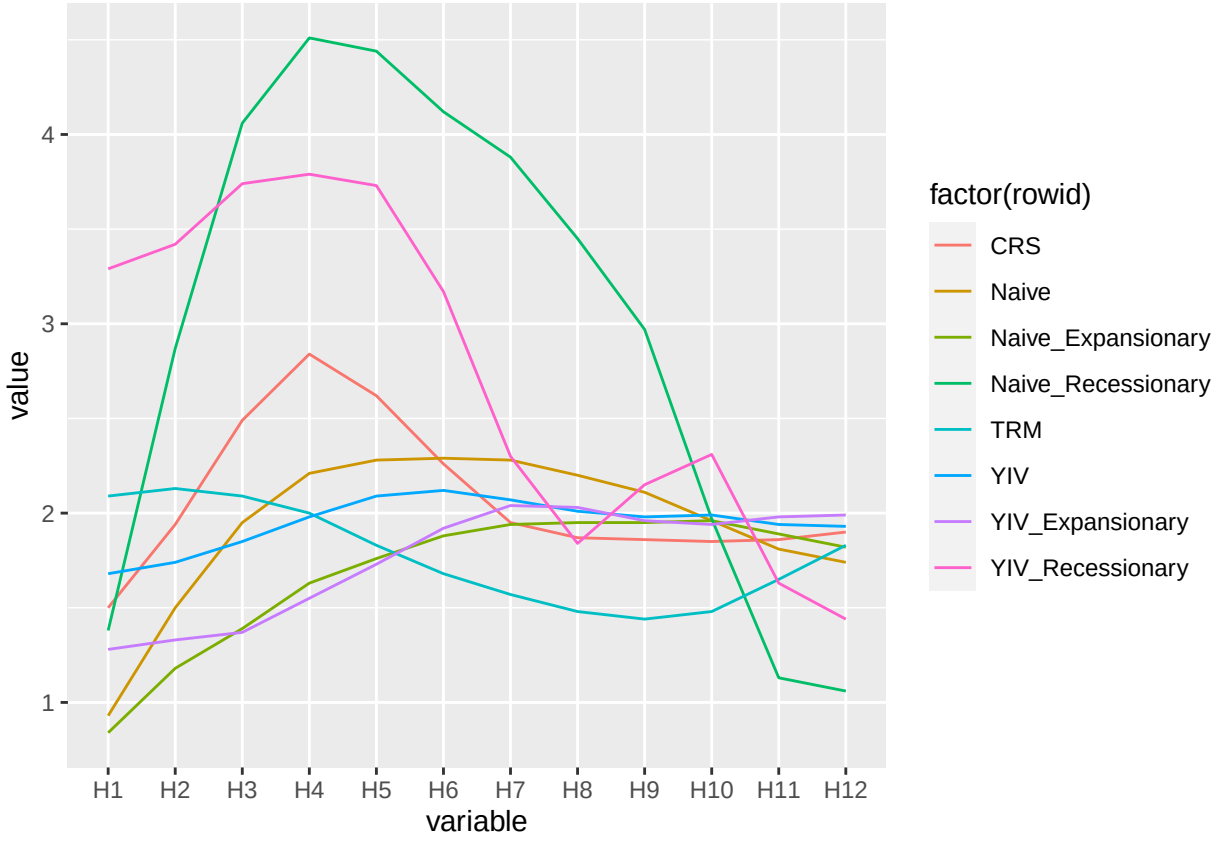
*** - p<0.01, ** - p<0.05, * - p<0.1. Reported standard error is adjusted for heteroskedasticity

```
##         Variables Tolerance      VIF
## 1             YIV 0.1217027 8.216744
## 2             dum 0.2154605 4.641222
## 3            lag2 0.3686612 2.712518
## 4            DGS1 0.1495779 6.685480
## 5          TRM1012 0.1988706 5.028395
## 6           SRT03M 0.3822738 2.615926
## 7          baa_aaa 0.1046499 9.555668
## 8             VIX 0.6408287 1.560479
## 9           housng 0.6964908 1.435769
## 10          gz_spr 0.1036346 9.649292
## 11 spy_logreturn 0.2005537 4.986195
## 12       YIV:dum 0.1058656 9.445943
```

1.9 Appendix I.

	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10	H11	H12
YIV	1.68	1.74	1.85	1.98	2.09	2.12	2.07	2.01	1.98	1.99	1.94	1.93
YIV_Recessionary	3.29	3.42	3.74	3.79	3.73	3.17	2.30	1.84	2.15	2.31	1.63	1.44
YIV_Expansionary	1.28	1.33	1.37	1.55	1.73	1.92	2.04	2.03	1.96	1.94	1.98	1.99
Naive	0.93	1.50	1.95	2.21	2.28	2.29	2.28	2.20	2.11	1.96	1.81	1.74
Naive_Recessionary	1.38	2.87	4.06	4.51	4.44	4.12	3.88	3.45	2.97	1.97	1.13	1.06
Naive_Expansionary	0.84	1.18	1.39	1.63	1.76	1.88	1.94	1.95	1.95	1.96	1.89	1.82
TRM	2.09	2.13	2.09	2.00	1.83	1.68	1.57	1.48	1.44	1.48	1.65	1.83
CRS	1.50	1.94	2.49	2.84	2.62	2.26	1.95	1.87	1.86	1.85	1.86	1.90

Note:
OOS refers to Out-of-sample



Appendix J.

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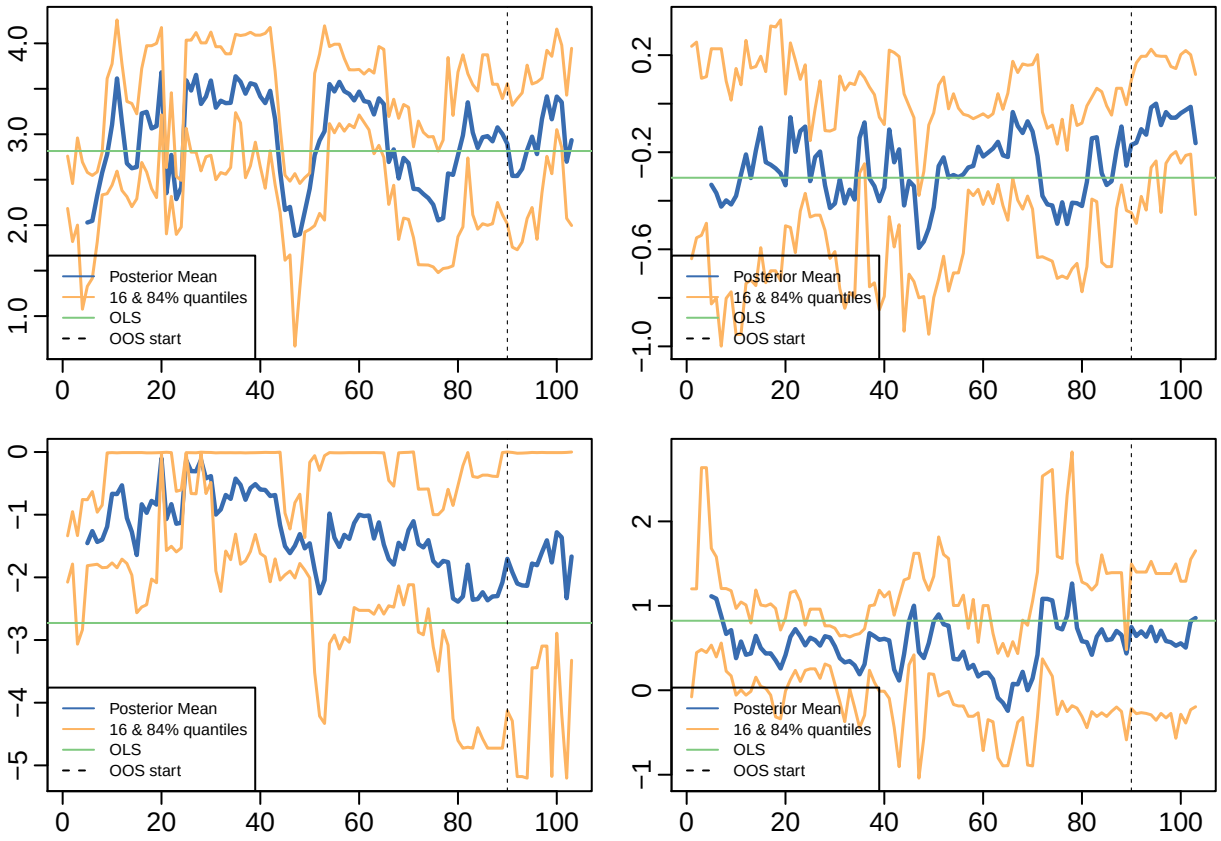

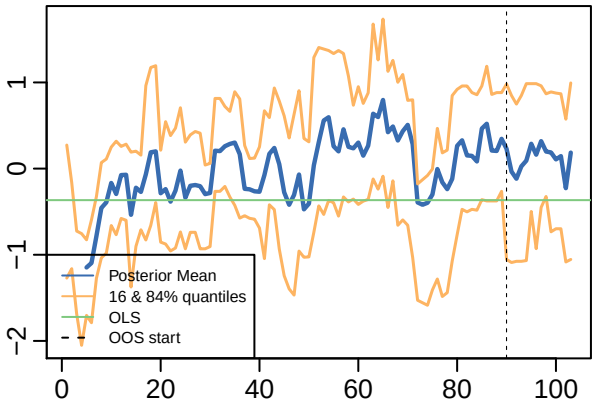
Posterior Mean
16 & 84% quantiles
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