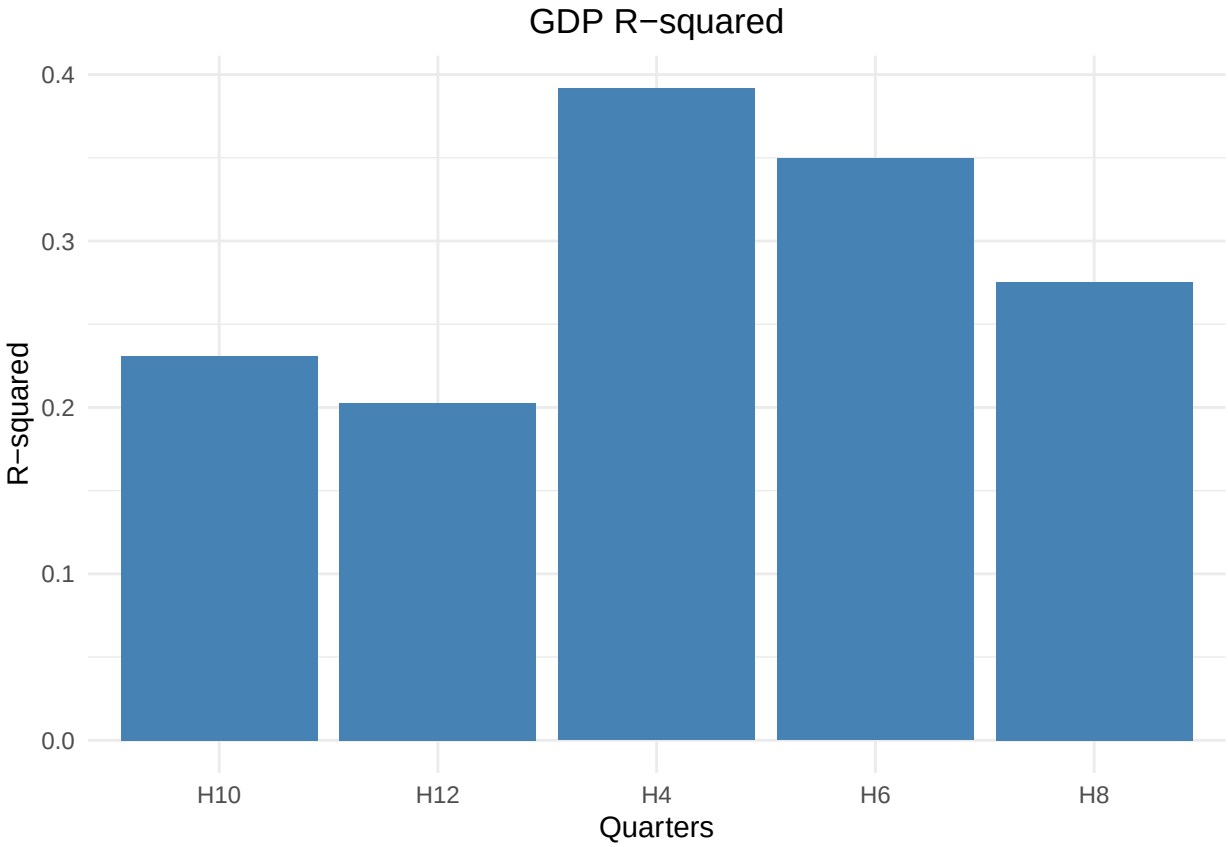
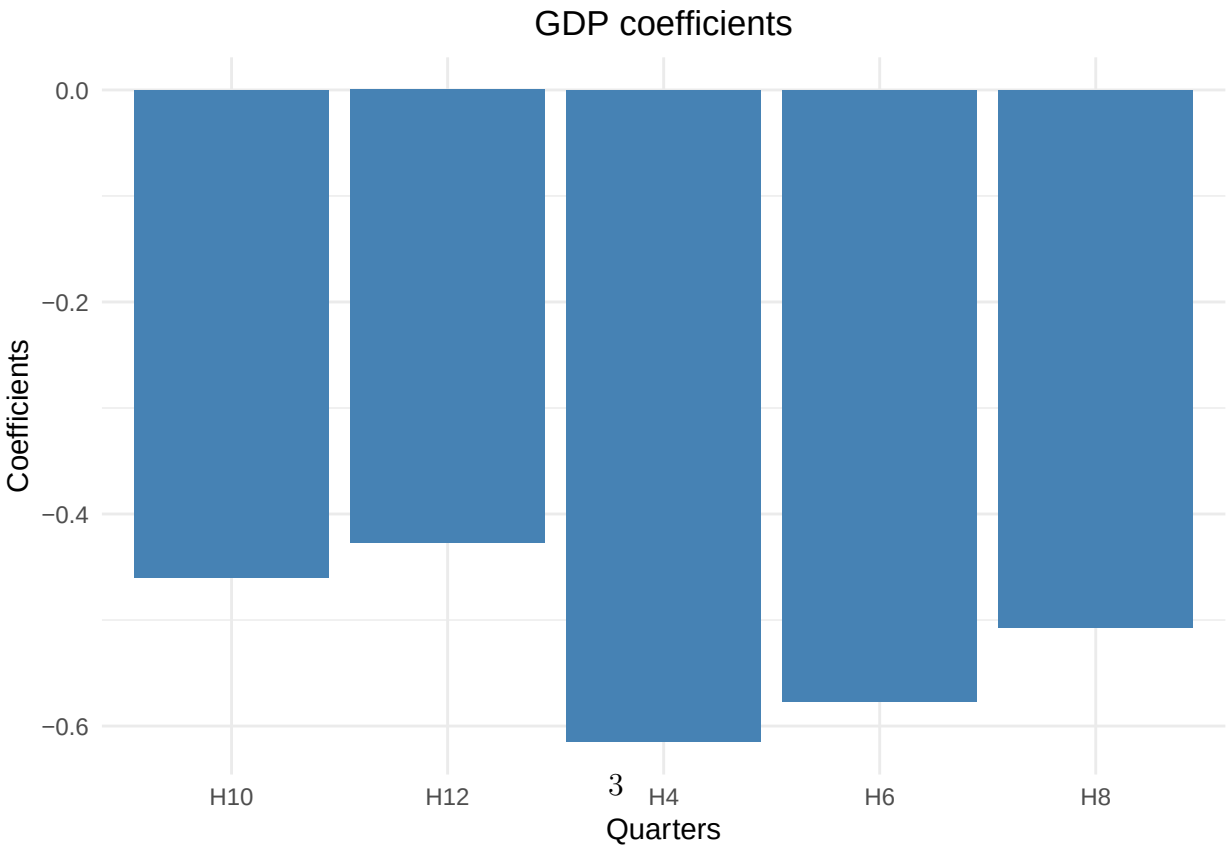
# Appendices

12.11-2020

# 1 Appendices

## 1.1 Appendix A



## 1.2 Appendix B

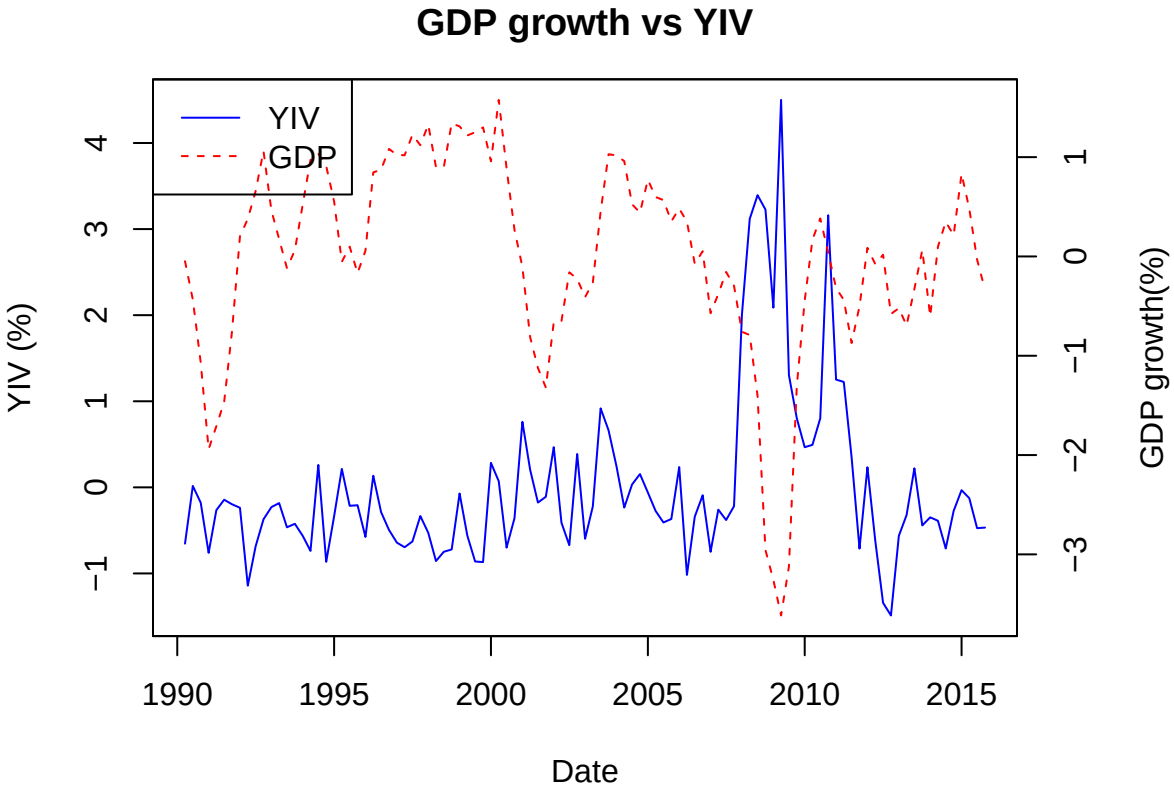



Figure 1.1: GDP Growth(%) vs 5-year Treasury Implied Volatility

## 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, different 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: SVEN1F01 - 1 year treasury bond par yield.

Table 1.1: Summary Statistics

| Variable | Mean | Std.Dev | Min | Q1 | Median | Q3 | Max | N.Valid |
|---|---|---|---|---|---|---|---|---|
| **Panel A: YIV** | | | | | | | | |
| AAA | 0 | 1 | -1.82 | -0.67 | -0.14 | 0.79 | 2.09 | 103 |
| **Panel B: Dependent Variables** | | | | | | | | |
| CON | 0 | 1 | -4.07 | -0.55 | 0.16 | 0.68 | 1.84 | 103 |
| DBAA | 0 | 1 | -1.83 | -0.68 | 0.05 | 0.70 | 2.33 | 103 |
| DGS1 | 0 | 1 | -1.32 | -1.17 | 0.09 | 0.89 | 2.14 | 103 |
| DGS10 | 0 | 1 | -1.75 | -0.74 | -0.04 | 0.76 | 2.14 | 103 |
| **Panel C: Control Variables** | | | | | | | | |
| DGS3MO | 0 | 1 | -1.26 | -1.20 | 0.08 | 0.93 | 2.18 | 103 |
| DGS5 | 0 | 1 | -1.69 | -0.94 | 0.13 | 0.80 | 2.10 | 103 |
| DGS6MO | 0 | 1 | -1.29 | -1.18 | 0.07 | 0.88 | 2.15 | 103 |
| EMP | 0 | 1 | -3.55 | -0.47 | 0.32 | 0.66 | 1.40 | 103 |
| F1 | 0 | 1 | -3.66 | -0.43 | 0.08 | 0.82 | 1.54 | 102 |
| F10 | 0 | 1 | -3.78 | -0.44 | 0.04 | 0.81 | 1.49 | 93 |
| F11 | 0 | 1 | -3.77 | -0.44 | 0.05 | 0.80 | 1.50 | 92 |
| F12 | 0 | 1 | -3.75 | -0.45 | 0.04 | 0.82 | 1.50 | 91 |
| F2 | 0 | 1 | -3.65 | -0.43 | 0.09 | 0.81 | 1.53 | 101 |
| F3 | 0 | 1 | -3.67 | -0.44 | 0.08 | 0.81 | 1.52 | 100 |
| F4 | 0 | 1 | -3.74 | -0.46 | 0.07 | 0.81 | 1.52 | 99 |
| F5 | 0 | 1 | -3.80 | -0.46 | 0.05 | 0.80 | 1.52 | 98 |
| F6 | 0 | 1 | -3.84 | -0.45 | 0.04 | 0.79 | 1.51 | 97 |
| F7 | 0 | 1 | -3.84 | -0.43 | 0.07 | 0.79 | 1.50 | 96 |
| F8 | 0 | 1 | -3.82 | -0.45 | 0.03 | 0.80 | 1.50 | 95 |
| F9 | 0 | 1 | -3.80 | -0.44 | 0.03 | 0.80 | 1.49 | 94 |
| GDP | 0 | 1 | -3.62 | -0.44 | 0.07 | 0.83 | 1.58 | 103 |
| housng | 0 | 1 | -3.01 | -0.39 | 0.21 | 0.64 | 2.22 | 103 |
| IND | 0 | 1 | -4.26 | -0.12 | 0.18 | 0.55 | 1.59 | 103 |
| lag10 | 0 | 1 | -3.52 | -0.46 | 0.08 | 0.84 | 1.49 | 93 |
| lag12 | 0 | 1 | -3.50 | -0.41 | 0.09 | 0.83 | 1.47 | 91 |
| lag4 | 0 | 1 | -3.62 | -0.47 | 0.08 | 0.84 | 1.53 | 99 |

Table 1.1: Summary Statistics *(continued)*

| Variable | Mean | Std.Dev | Min | Q1 | Median | Q3 | Max | N.Valid |
|---|---|---|---|---|---|---|---|---|
| lag6 | 0 | 1 | -3.58 | -0.46 | 0.08 | 0.83 | 1.52 | 97 |
| lag8 | 0 | 1 | -3.55 | -0.46 | 0.08 | 0.85 | 1.51 | 95 |
| SRT03M | 0 | 1 | -3.13 | -0.19 | 0.16 | 0.38 | 2.18 | 102 |
| TRM0503 | 0 | 1 | -2.31 | -0.80 | 0.12 | 0.82 | 1.93 | 103 |
| TRM0506 | 0 | 1 | -2.19 | -0.75 | 0.14 | 0.76 | 1.95 | 103 |
| TRM1003 | 0 | 1 | -2.20 | -0.90 | 0.15 | 0.77 | 1.54 | 103 |
| TRM1006 | 0 | 1 | -2.07 | -0.88 | 0.14 | 0.78 | 1.59 | 103 |
| TRM1012 | 0 | 1 | -1.84 | -0.88 | 0.14 | 0.87 | 1.66 | 103 |
| VIX | 0 | 1 | -1.20 | -0.77 | -0.31 | 0.57 | 5.30 | 103 |
| YIV | 0 | 1 | -1.49 | -0.56 | -0.26 | 0.22 | 4.50 | 103 |

*Note:*
Additional control variables will be added upon construction. Furthermore, currently the frequency of the datasets differs for different variables but this will be addressed in the research process.

## 1.4 Appendix D.

Notes: This table depicts the output of regression with YIV as only independent variable.

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

Table 1.2: Regression output

| | H4 | H6 | H8 | H10 | H12 |
|---|---|---|---|---|---|
| | | | **Panel A: YIV** | | |
| (Intercept)_estimate | 0.01 | 0.01 | 0.02 | 0.02 | 0.02 |
| (Intercept)_std.error | 0.15 | 0.16 | 0.17 | 0.19 | 0.20 |
| (Intercept)_p.value | 0.96 | 0.94 | 0.93 | 0.94 | 0.92 |
| YIV_estimate | -0.61 | -0.58 | -0.51 | -0.46 | -0.43 |
| YIV_std.error | 0.15 | 0.15 | 0.13 | 0.11 | 0.10 |
| 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 |
| RMSE | 0.78 | 0.81 | 0.86 | 0.88 | 0.90 |

*Note:*

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

## 1.5 Appendix E.

Notes: This table includes regression using GDP & YIV. Controls will be added during research process. The equation for the regression is the following:

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

Table 1.3: Regression with state-dependency

| | H4 | H6 | H8 | H10 | H12 |
|---|---|---|---|---|---|
| | | | **Panel A** | | |
| (Intercept)_estimate | 0.01 | 0.02 | 0.02 | 0.02 | 0.02 |
| (Intercept)_std.error | 0.09 | 0.09 | 0.13 | 0.18 | 0.20 |
| (Intercept)_p.value | 0.90 | 0.84 | 0.87 | 0.90 | 0.91 |
| YIV_estimate | -0.33 | -0.32 | -0.30 | -0.30 | -0.30 |
| YIV_std.error | 0.08 | 0.09 | 0.08 | 0.08 | 0.08 |
| YIV_p.value | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| dum_estimate | -0.54 | -0.50 | -0.40 | -0.30 | -0.24 |
| dum_std.error | 0.08 | 0.06 | 0.07 | 0.07 | 0.07 |
| 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 |
| RMSE | 0.63 | 0.69 | 0.78 | 0.85 | 0.88 |

*Note:*

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

## 1.6 Appendix F.

Notes: This table includes regression using GDP & YIV and controls.

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

Table 1.4: Regression with state-dependency

| | H4 | H6 | H8 | H10 | H12 |
|---|---|---|---|---|---|
| | | | **Panel A** | | |
| (Intercept)_estimate | 0.02 | 0.03 | 0.01 | -0.02 | -0.04 |
| (Intercept)_std.error | 0.07 | 0.08 | 0.09 | 0.10 | 0.10 |
| (Intercept)_p.value | 0.72 | 0.68 | 0.94 | 0.82 | 0.72 |
| YIV_estimate | -0.11 | -0.14 | -0.14 | -0.16 | -0.15 |
| YIV_std.error | 0.07 | 0.08 | 0.08 | 0.06 | 0.06 |
| YIV_p.value | 0.10 | 0.10 | 0.06 | 0.01 | 0.01 |
| dum_estimate | -0.41 | -0.42 | -0.38 | -0.32 | -0.30 |
| dum_std.error | 0.08 | 0.10 | 0.10 | 0.09 | 0.07 |
| dum_p.value | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| DGS1_estimate | 4.82 | 7.16 | 10.28 | 12.66 | 14.74 |
| DGS1_std.error | 1.94 | 2.23 | 2.36 | 2.55 | 2.71 |
| DGS1_p.value | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 |
| DGS10_estimate | -1.57 | -1.38 | -0.79 | -0.38 | 0.03 |
| DGS10_std.error | 0.84 | 1.09 | 1.05 | 1.04 | 1.03 |
| DGS10_p.value | 0.07 | 0.21 | 0.45 | 0.72 | 0.98 |
| DGS5_estimate | -5.92 | -11.60 | -16.45 | -19.01 | -21.81 |
| DGS5_std.error | 2.83 | 3.29 | 3.80 | 4.01 | 4.19 |
| DGS5_p.value | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 |
| DGS3MO_estimate | 3.33 | 7.04 | 8.28 | 7.91 | 8.21 |
| DGS3MO_std.error | 1.91 | 2.28 | 2.51 | 2.43 | 2.33 |
| DGS3MO_p.value | 0.08 | 0.00 | 0.00 | 0.00 | 0.00 |
| TRM0506_estimate | 2.85 | 4.89 | 6.17 | 6.69 | 7.38 |
| TRM0506_std.error | 1.16 | 1.38 | 1.49 | 1.50 | 1.50 |
| TRM0506_p.value | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 |
| SRT03M_estimate | 0.05 | 0.13 | 0.14 | 0.07 | 0.00 |
| SRT03M_std.error | 0.06 | 0.10 | 0.13 | 0.12 | 0.10 |
| SRT03M_p.value | 0.37 | 0.22 | 0.28 | 0.55 | 0.96 |
| AAA_estimate | 1.71 | 1.26 | 1.47 | 1.95 | 2.31 |
| AAA_std.error | 0.58 | 0.66 | 0.74 | 0.89 | 0.93 |
| AAA_p.value | 0.00 | 0.06 | 0.05 | 0.03 | 0.02 |
| DBAA_estimate | -1.43 | -0.85 | -0.67 | -0.81 | -0.92 |
| DBAA_std.error | 0.35 | 0.48 | 0.45 | 0.45 | 0.46 |

| | | | | | |
|---|---|---|---|---|---|
| DBAA_p.value | 0.00 | 0.08 | 0.14 | 0.08 | 0.05 |
| VIX_estimate | -0.01 | 0.00 | -0.04 | -0.01 | 0.00 |
| VIX_std.error | 0.05 | 0.06 | 0.07 | 0.07 | 0.07 |
| VIX_p.value | 0.91 | 0.94 | 0.56 | 0.92 | 0.96 |
| housng_estimate | 0.06 | 0.06 | 0.13 | 0.20 | 0.15 |
| housng_std.error | 0.06 | 0.07 | 0.08 | 0.10 | 0.09 |
| housng_p.value | 0.33 | 0.37 | 0.13 | 0.05 | 0.10 |
| r.squared | 0.79 | 0.75 | 0.70 | 0.69 | 0.70 |
| adj.r.squared | 0.76 | 0.71 | 0.65 | 0.64 | 0.66 |
| RMSE | 0.49 | 0.54 | 0.59 | 0.60 | 0.59 |

*Note:*

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

## 1.7 Appendix H.

| | H1 | H2 | H3 | H4 | H5 | H6 | H7 | H8 | H9 | H10 | H11 | H12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Out-of-sample RMSFE | 0.95 | 0.98 | 1.05 | 1.13 | 1.21 | 1.24 | 1.21 | 1.17 | 1.15 | 1.15 | 1.12 | 1.10 |
| Recessionary | 1.87 | 1.94 | 2.12 | 2.17 | 2.17 | 1.85 | 1.34 | 1.07 | 1.24 | 1.33 | 0.94 | 0.82 |
| Expansionary | 0.73 | 0.75 | 0.78 | 0.89 | 1.00 | 1.12 | 1.19 | 1.18 | 1.13 | 1.12 | 1.14 | 1.14 |
| Naive | 0.53 | 0.85 | 1.10 | 1.27 | 1.32 | 1.34 | 1.33 | 1.28 | 1.22 | 1.13 | 1.04 | 1.00 |
| TRM | 1.02 | 0.96 | 0.93 | 1.01 | 1.00 | 0.94 | 0.91 | 0.86 | 0.90 | 0.93 | 1.02 | 1.12 |
| CRS | 0.84 | 1.08 | 1.41 | 1.62 | 1.51 | 1.33 | 1.13 | 1.05 | 1.04 | 1.02 | 1.00 | 0.97 |