COMPUTATIONAL FINANCE & RISK MANAGEMENT
UNIVERSITY of WASHINGTON
Department of Applied Mathematics

DCC GARCH

Amath 546/Econ 589
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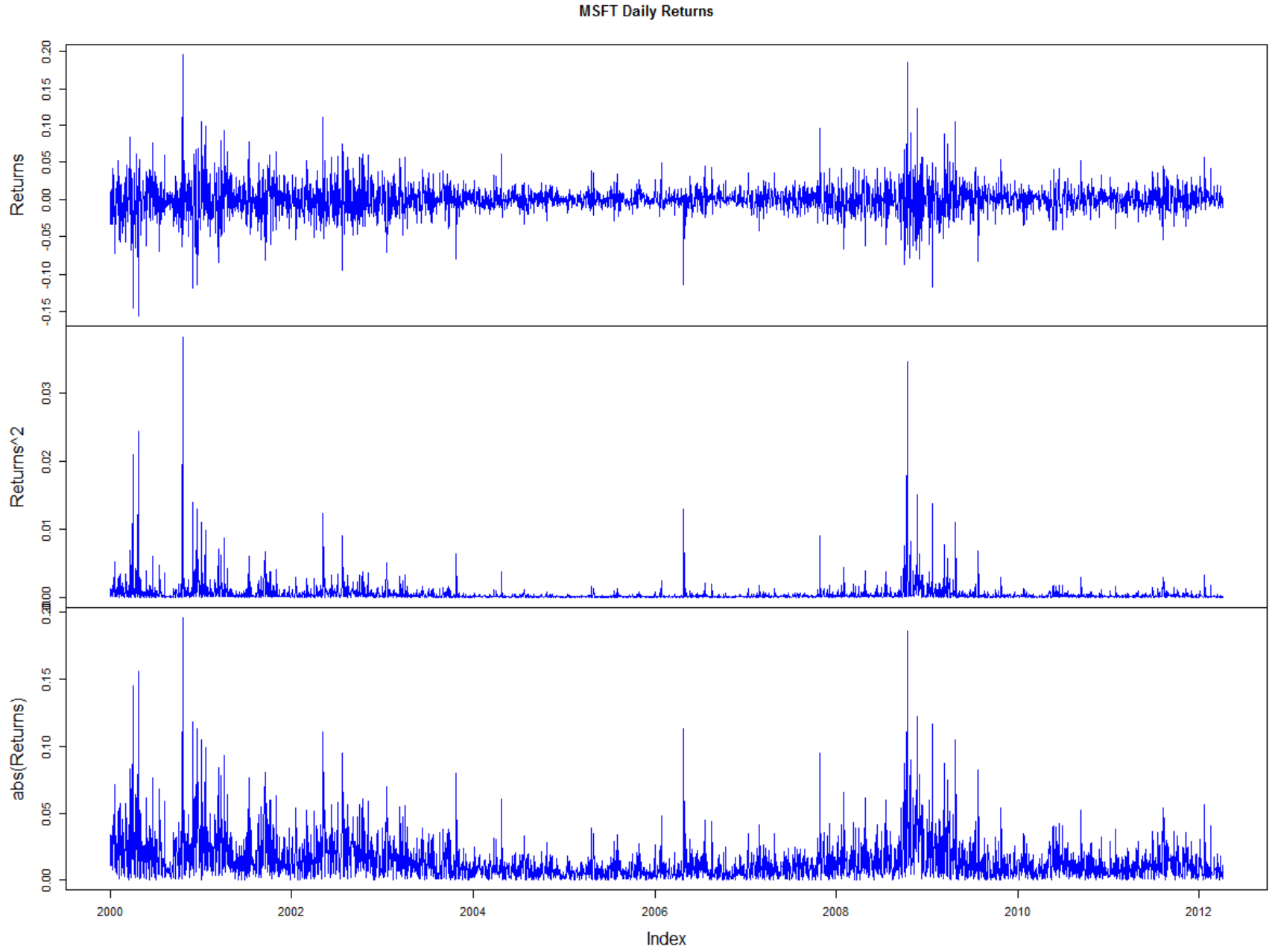
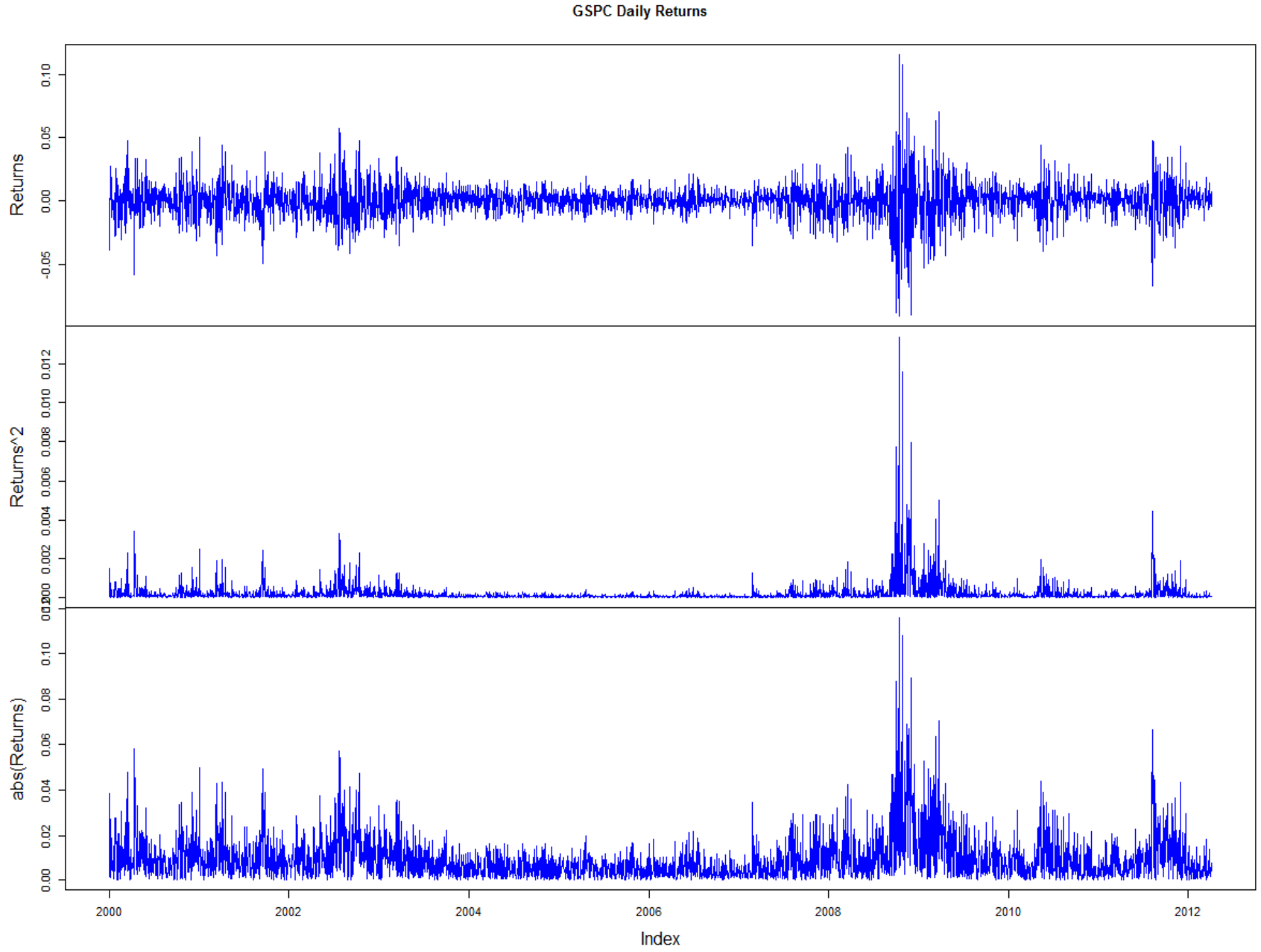
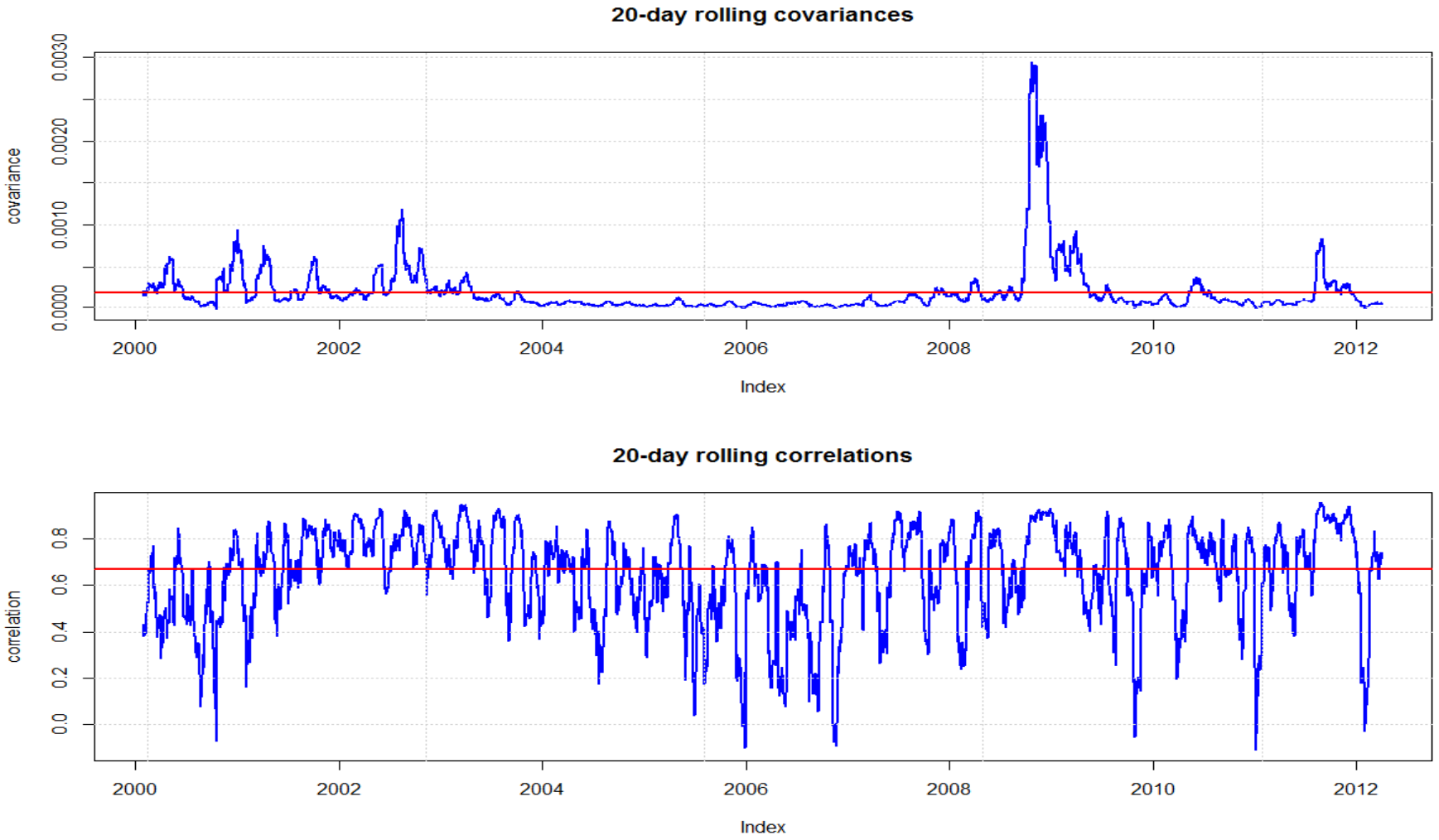

MSFT Daily Returns
Returns
Returns^2
abs(Returns)
Index
2000
2002
2004
2006
2008
2010
2012

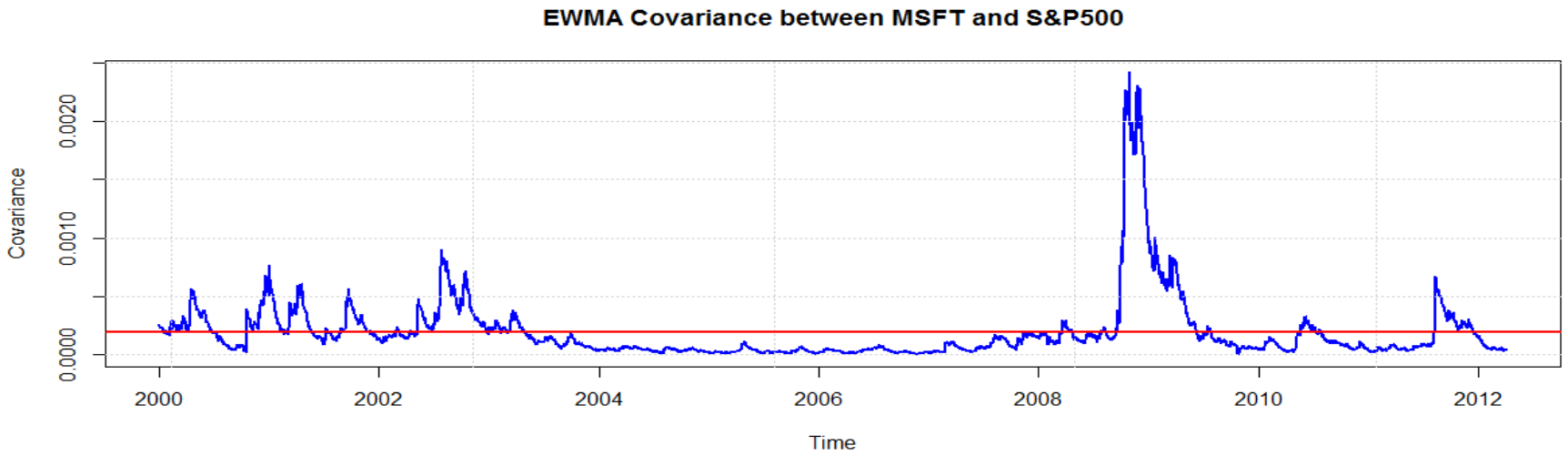

GSPC Daily Returns
Returns
Returns^2
abs(Returns)
0.10
0.05
0.00
-0.05
0.012
0.010
0.008
0.006
0.004
0.002
0.000
0.10
0.08
0.06
0.04
0.02
0.00
2000
2002
2004
2006
2008
2010
2012
Index

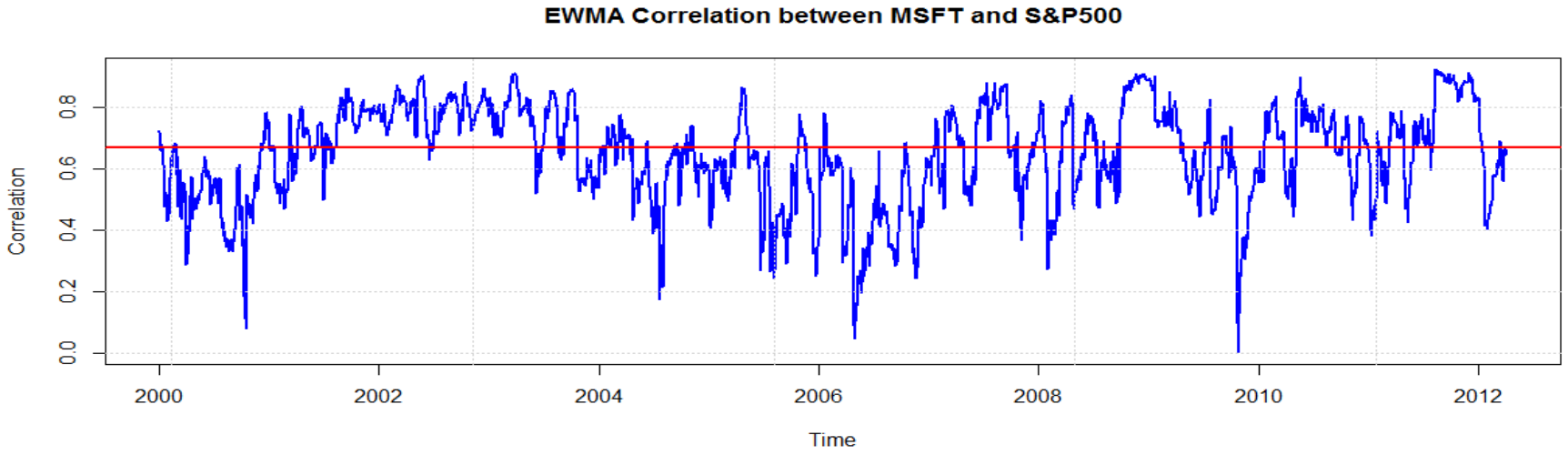
Rolling Covariances and Correlations



EWMA Covariances and Correlations

$\lambda = 0.94$





Specify DCC Model

```
# univariate normal GARCH(1,1) for each series
> garch11.spec = ugarchspec(mean.model = list(armaOrder = c(0,0)),
+                           variance.model = list(garchOrder = c(1,1),
+                           model = "sGARCH"),
+                           distribution.model = "norm")

# dcc specification - GARCH(1,1) for conditional correlations
> dcc.garch11.spec = dccspec(uspec = multispec( replicate(2,
garch11.spec) ),
+                            dccOrder = c(1,1),
+                            distribution = "mvnorm")

> dcc.garch11.spec

*---------------------------------*
*       DCC GARCH Spec            *
*---------------------------------*
Model                 :  DCC(1,1)
Estimation            :  2-step
Distribution          :  mvnorm
No. of Parameters     :  11
No. of Series         :  2
```

Estimate DCC Model

```
> dcc.fit = dccfit(dcc.garch11.spec, data = MSFT.GSPC.ret)

Iter: 1 fn: 2261.1651   Pars:  0.02425 0.96193
Iter: 2 fn: 2261.1651   Pars:  0.02425 0.96192
solnp--> Completed in 2 iterations

> class(dcc.fit)
[1] "DCCfit"
attr(,"package")
[1] "rmgarch"

> slotNames(dcc.fit)
[1] "mfit"  "model"

> names(dcc.fit@mfit)
 [1] "coef"          "matcoef"       "garchnames"
 [4] "dccnames"      "cvar"          "scores"
 [7] "R"             "H"             "Q"
[10] "stdresid"      "llh"           "log.likelihoods"
[13] "timer"         "convergence"   "Nbar"
[16] "Qbar"
```

Estimate DCC Model

```
> names(dcc.fit@model)
 [1] "modelinc"      "modeldesc"     "modeldata"     "varmodel"
 [5] "pars"          "start.pars"    "fixed.pars"    "maxgarchOrder"
 [9] "maxdccOrder"   "pos.matrix"    "pidx"          "mu"
[13] "residuals"     "sigma"         "mpars"         "ipars"
[17] "midx"          "eidx"          "umodel"

# many extractor functions - see help on DCCfit object
# coef, likelihood, rshape, rskew, fitted, sigma,
# residuals, plot, infocriteria, rcor, rcov
# show, nisurface
```

Estimate DCC Model

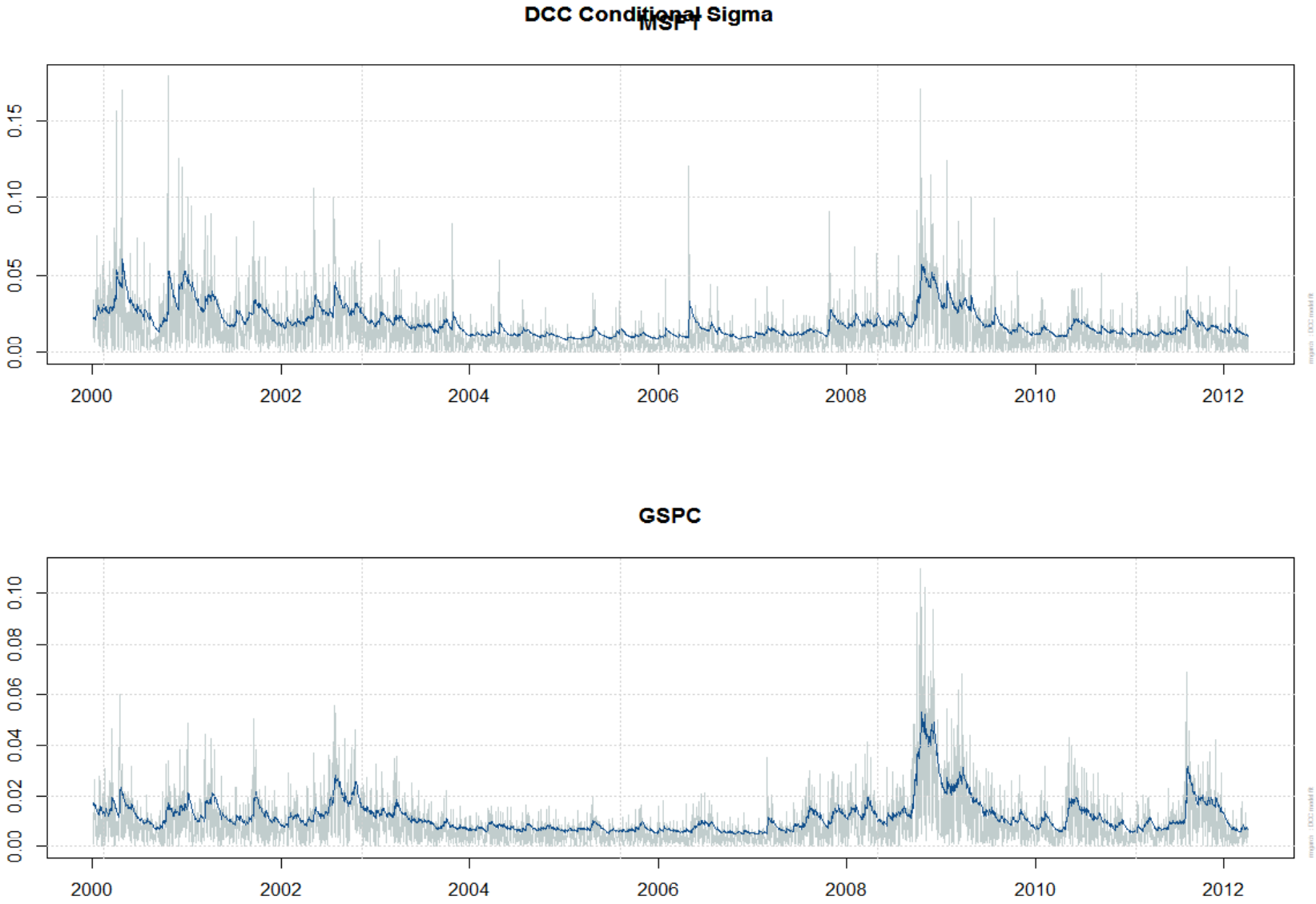
```
> dcc.fit
*---------------------------------*
*          DCC GARCH Fit          *
*---------------------------------*

Distribution                :  mvnorm
DCC Order                   :  1 1
Asymmetric                  :  FALSE
No. of Parameters           :  11
[VAR GARCH DCC UncQ]        : [0+8+2+1]
No. of Series               :  2
No. of Observations         :  3082
Log-Likelihood              :  18417
Av.Log-Likelihood           :  5.98

Optimal Parameters
------------------------------------------------------------
                Estimate  Std. Error  t value Pr(>|t|)
[MSFT].mu       0.000343    0.000289   1.1881 0.234808
[MSFT].omega    0.000005    0.000002   2.4441 0.014522
[MSFT].alpha1   0.069238    0.029389   2.3559 0.018478
[MSFT].beta1    0.920378    0.029791  30.8943 0.000000
[GSPC].mu       0.000434    0.000168   2.5894 0.009613
[GSPC].omega    0.000001    0.000000   3.3236 0.000889
[GSPC].alpha1   0.088147    0.014425   6.1109 0.000000
[GSPC].beta1    0.903222    0.016831  53.6630 0.000000
[Joint]dcca1    0.024249    0.011018   2.2008 0.027749
[Joint]dccb1    0.961925    0.022314  43.1090 0.000000
```

Conditional correlation parameters (with covariance targeting)

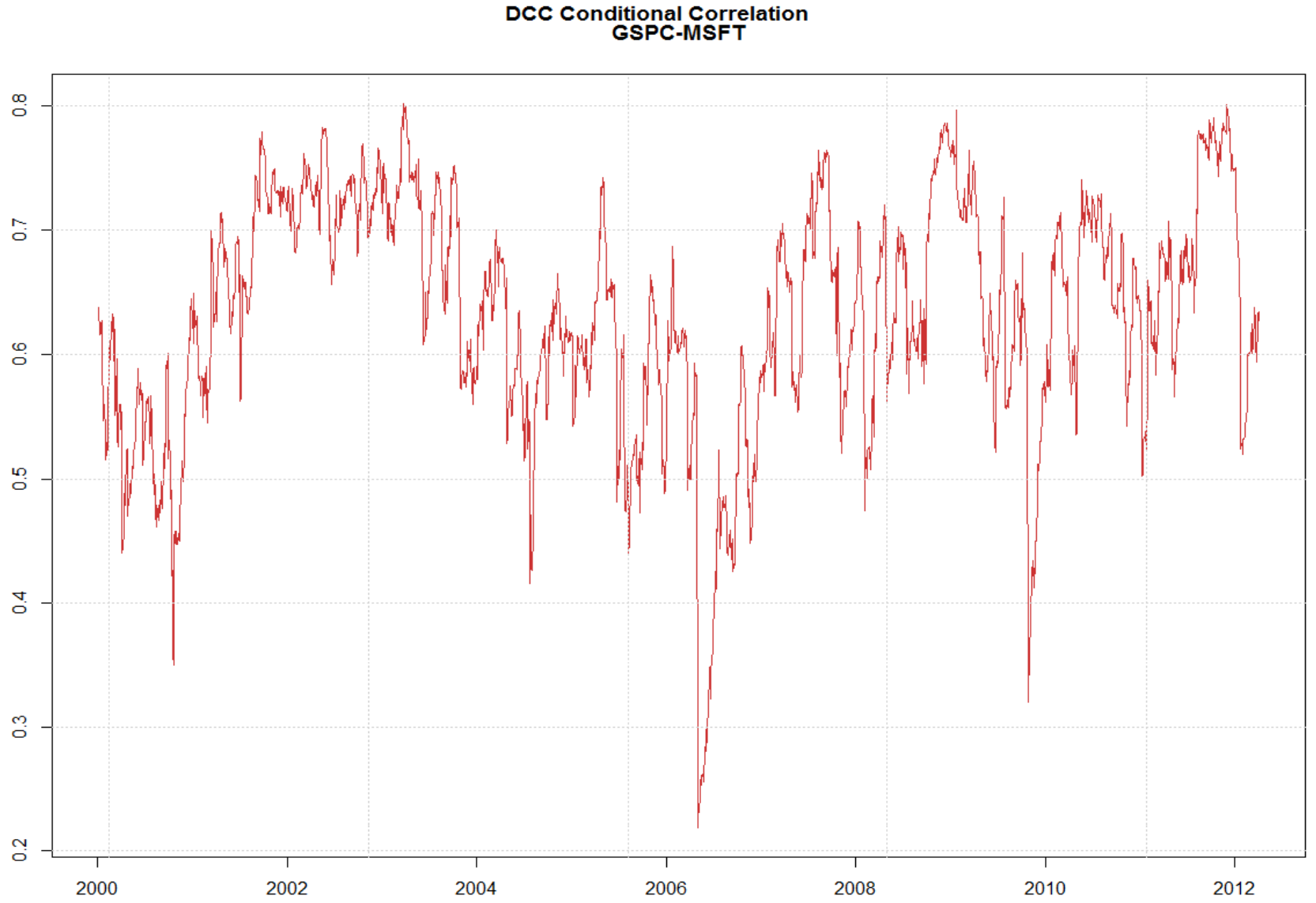
DCCfit Plot Method

```
> plot(dcc.fit)

Make a plot selection (or 0 to exit):

1:   Conditional Mean (vs Realized Returns)
2:   Conditional Sigma (vs Realized Absolute Returns)
3:   Conditional Covariance
4:   Conditional Correlation
5:   EW Portfolio Plot with conditional density VaR limits

Selection:
```

GARCH(1,1) Conditional Variances



Conditional Correlations



DCC Forecasts

```
# 100-step ahead forecasts of conditional covariances
# and conditional correlations
> dcc.fcst = dccforecast(dcc.fit, n.ahead=100)
> class(dcc.fcst)
[1] "DCCforecast"
attr(,"package")
[1] "rmgarch"

> slotNames(dcc.fcst)
[1] "mforecast" "model"

> class(dcc.fcst@mforecast)
[1] "list"

> names(dcc.fcst@mforecast)
[1] "H"    "R"    "Q"    "Rbar" "mu"
```

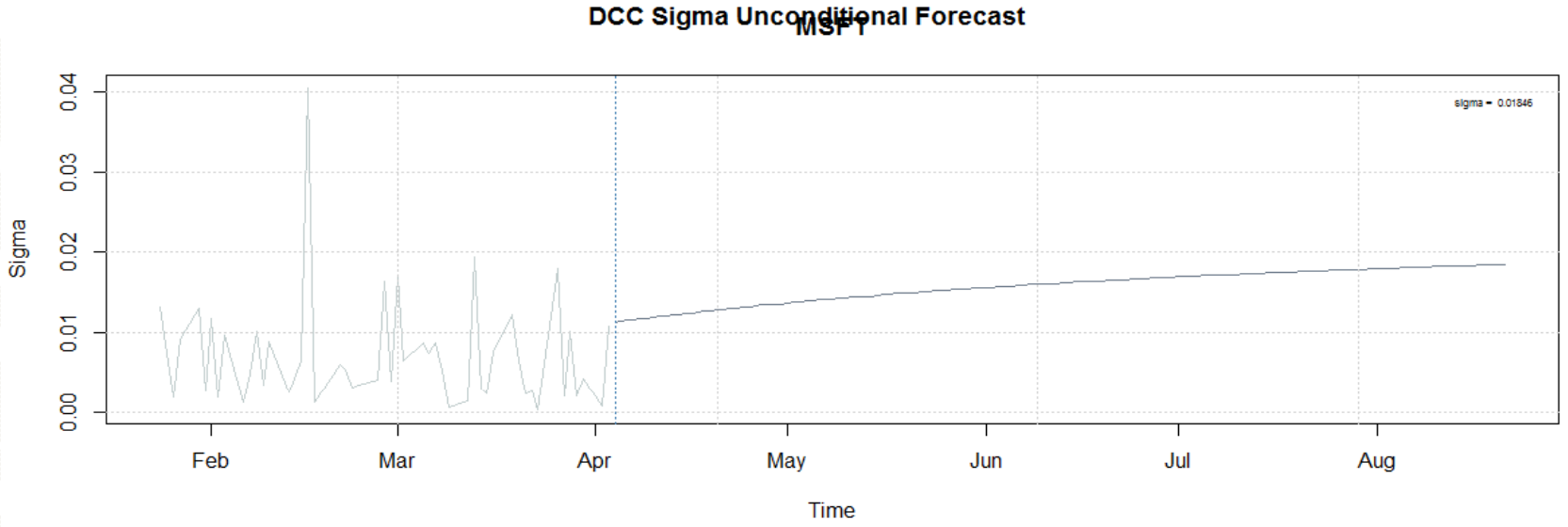
DCC Forecasts

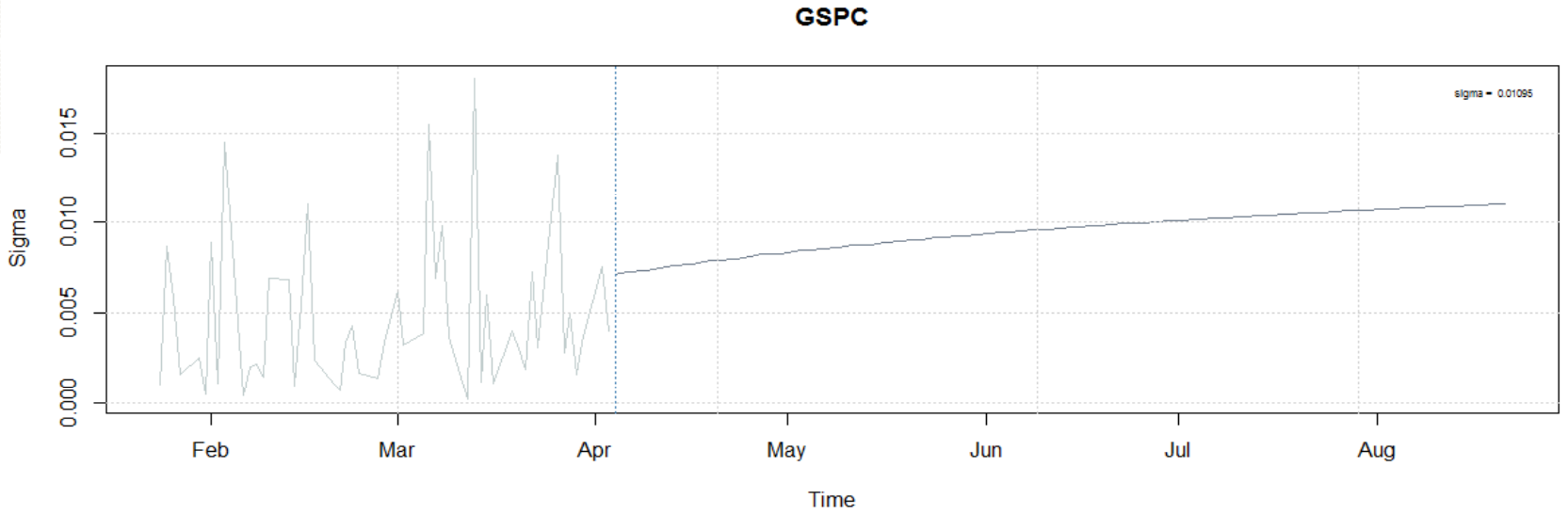
```
> dcc.fcst
*---------------------------------*
*       DCC GARCH Forecast        *
*---------------------------------*

Distribution       :
Horizon            :
Roll Steps         :
---------------------------------

0-roll forecast:

First 2 Correlation Forecasts
, , 1
       [,1]   [,2]
[1,] 1.0000 0.6324
[2,] 0.6324 1.0000

, , 2
       [,1]   [,2]
[1,] 1.0000 0.6324
[2,] 0.6324 1.0000

Last 2 Correlation Forecasts
, , 1
       [,1]   [,2]
[1,] 1.0000 0.6298
[2,] 0.6298 1.0000

, , 2
       [,1]   [,2]
[1,] 1.0000 0.6298
[2,] 0.6298 1.0000
```

DCC Forecasts

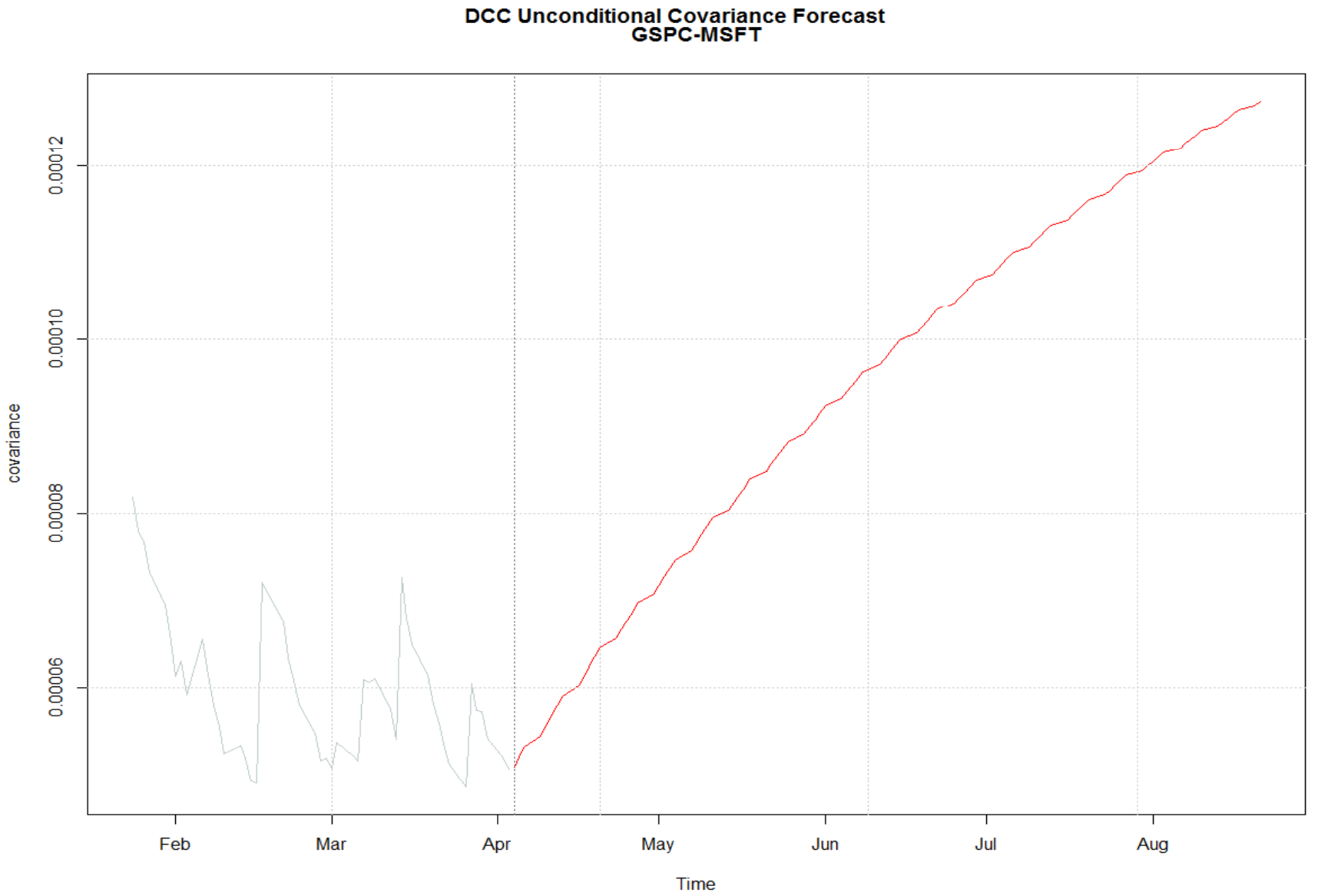
```
> plot(dcc.fcst)

Make a plot selection (or 0 to exit):

1:   Conditional Mean Forecast (vs Realized Returns)
2:   Conditional Sigma Forecast (vs Realized Absolute Returns)
3:   Conditional Covariance Forecast
4:   Conditional Correlation Forecast
5:   EW Portfolio Plot with forecast conditional density VaR limits

Selection:
```

Conditional Variance Forecasts





Conditional Covariance Forecasts



Conditional Correlation Forecast