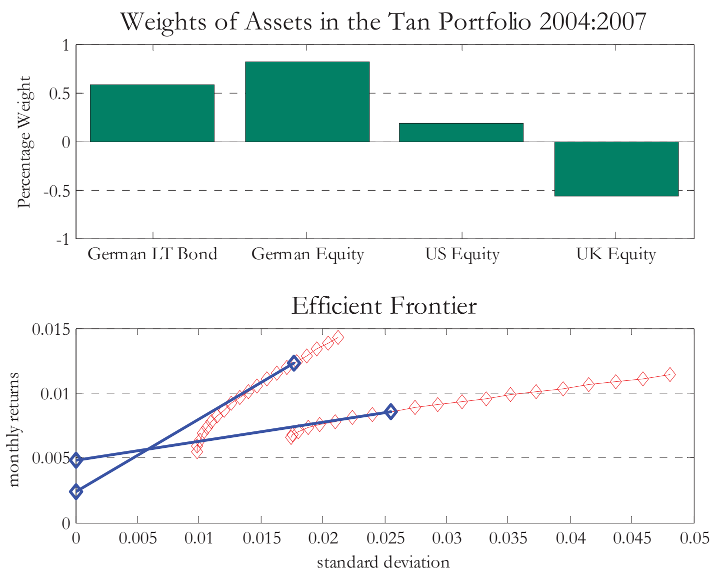
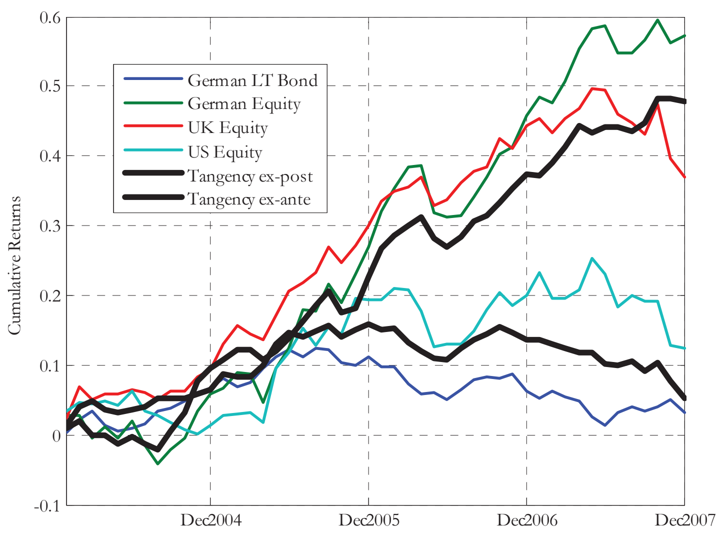
```
   run Figure003
   % % ------------------------------------------------------------------------
   % ------------ Compute the weights and efficient frontier using information
from 2004 to 2007
   % ------------------------------------------------------------------------
   muR_end = mean(R2)';
   SigmaR_end = cov(R2);
   % WEIGHTS
   WeightsTP_end = ((SigmaR_end^(-1))*muR_end)./(ones(4,1)'*(SigmaR_end^(-1)*muR_end))
   % Performance
   Rport_end = R2*WeightsTP_end;
   PerfPort_end = cumsum(Rport_end);
   %Efficient Frontier
   NumPortf = 20; % number of efficient portfolios to be computed
    % we do not compute all efficient portfolios in the
    % efficient frontier (there is a continuum of them)
    % we compute only a subset of them, equally spaced between
    % the minimum variance portfolio and the portfolio with the
    % highest return.
   mu_end=mean(R2)+ mean(GER.RiskFree(ps:pe)); %generate mean returns
   % generate mean variance efficient frontier
   [WeightsMV_end, MuMeanVariance_end, StdMeanVariance_end] = effront(mu_end,
SigmaR_end, NumPortf);
   %mean variance for risk free and tangency portfolio
   Mu_bm_end = zeros(2, 1);
   SD_bm_end = zeros(2, 1);
   Mu_bm_end(1,1) = mean(GER.RiskFree(ps:pe));
   SD_bm_end(1,1)=0;
   Mu_bm_end(2,1)=mu_end*WeightsTP_end;
   SD_bm_end(2,1)=sqrt(WeightsTP_end'*SigmaR_end*WeightsTP_end);
   % Plot Weights, efficient frontier and comparative performance
   run Figure004
```

By running figure003.m and figure004.m the following output is obtained:





## 4.4. *The resampled optimal portfolio and efficient frontier*

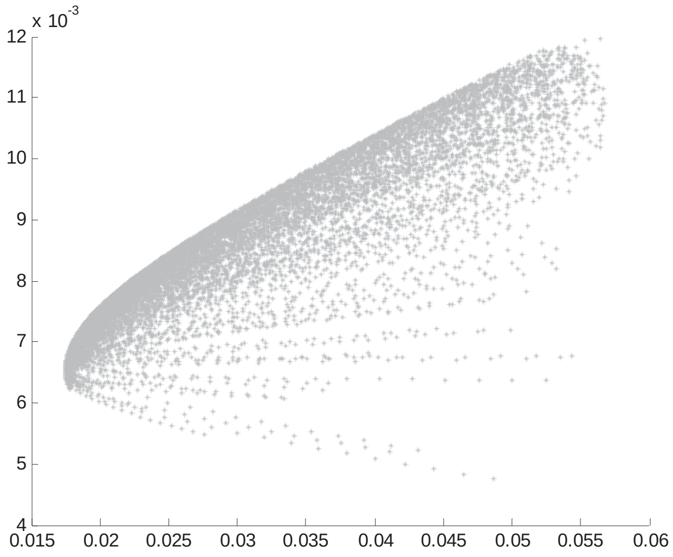
Next we consider re-sampling. Note that the two ruotines resampfront.m and resamptp.m allow to compute resampled efficient frontiers and tangency portfolio based either on Monte-Carlo methods ot bootstrap upon user's choice.

The section is articulate in five steps:

```
% % -----------------------------------------------------------------------
% ------------ Resampled Efficient Frontier and Tangency Portfolio
% -----------------------------------------------------------------------
% % Step 1.  Construct the relevant time series of returns
RetSeries = [GER.LTBond.Ret(ss:se) GER.Stock.Ret(ss:se) UK.Stock.Ret(ss:se) US.Stock.Ret(ss:se)];
ExRetSeries=[GER.LTBond.ExRet(ss:se) GER.Stock.ExRet(ss:se) UK.Stock.ExRet(ss:se) US.Stock.ExRet(ss:se)];
% % Step 2.  Compute the Resampled Frontier
NumPortf = 20;
NumSimu = 1000;
[Wrsp,ERrsp,SDrsp,Wmv,MuMv,StdMv,Wmv_S,ERmv_S,SDmv_S] = resampfront(RetSeries, NumPortf, NumSimu,1);
[Wtp,Wtprsp,Wtprsp_S] = resamptp(ExRetSeries, NumSimu,1);
% Note:
% The outputs in the resampfront are the following:
% Wrsp = NumAssets time NumPortf matrix collecting the resampled portfolio weights
% ERrsp = Column vector collecting resampled portfolio expected returns
% SRrsp = Column vector collecting resampled portfolio standard deviations
% Wmv = Matrix collecting the mean-variance weights
% ERmv = Column vector collecting mean-variance portfolio expected returns
% SDmv = Column vector collecting mean-variance portfolio standard deviations
% Wmv_S = Array collecting the simulated mean-variance weights for statistical analysis purposes
% The outputs in the resamptp
% Wtp = NumAssetx1 vector of weights on the TP.
% Wtprsp = NumAsset*1 vector of mean TP weights in bootstrap.
% Wtprsp_S = NumAssets*1*NumSimu array collecting the simulated
% weights (useful for statistical analysis).
% % Step 3.  Plots the statistical equivalence region and the resampled frontier
stateqregion(RetSeries, MuMv, StdMv,Wmv_S)
bsfrontier(MuMv,StdMv,MuMeanVariance_end, StdMeanVariance_end,ERmv_S,SDmv_S)
```

```
% % Step 4.  Compare Performance of actual on BS Portfolio on smpl 2
Rport_bt = R2*Wtprsp;
PerfPort_bt = cumsum(Rport_bt);
run Figure005
% % Step 5.  Generates the output statistics
PortfSet1=[1:20];
ConfLevel=5; % The confidence level
[Stats] = Statistics(Wmv, Wmv_S, Wrsp, PortfSet1, ConfLevel); % Collect the
simulations statistics
```

Staeqregion.m  and bs.frontier.m generate output that allow to evaluate the uncertainty on the position of the frontier and the inefficient portfolios that are statistically equivalent to those on the frontier. Finally the performance out-of-sample of portfolio allocation based on resampled weights is compared with those of the optimal ex-ante and ex-post portfolios.


x 10^-3
12
11
10
9
8
7
6
5
4
0.015
0.02
0.025
0.03
0.035
0.04
0.045
0.05
0.055
0.06