Study of Rapach and Zhou's 2012 paper uing updated data

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Runs 14 regressors including market info and macro factors on equity premium Predicts out of sample market returns and compare with historical average benchmark prediction. Includes predictions using Kitchen-sink and POOL-avg prediction

helper functions

```
warning('off','all')
dbtype predict_r.m
dbtype plot_pred.m
dbtype plot_pred_perf.m
```

```
1     function pred = predict_r(X,y,test_idx)
2         l = length(X);
3         const_ones = ones(l,1);
4         pred = zeros(l-test_idx+1,1);
5         for i = 1: l-test_idx+1
6             hist_l = test_idx-2+i;
7             beta = regress(y(2:hist_l),[const_ones(1:hist_l-1) X(1:hist_
8             pred(i) = [1 X(hist_l,:)]*beta;
9         end
10
11    end
```

```
1     function plot_pred(pred, r_avg, test_year,custom_ylim,label)
2         l = length(pred(:,1));
3         x_year = test_year:1/12:(test_year+l/12);
4         plot(x_year,zeros(length(x_year),1),'color',[0 0 0]+0.5)
5
6         plot(x_year,[0; pred],'color',[0 0 0])
7         plot(x_year,[0; r_avg],'color',[0 0 0]+0.7)
8         xlim([test_year test_year+l/12]+1/12)
9         ylim(custom_ylim)
10        title(label)
11        set(gca, 'XTick', 1965:10:2015)
12    end
```

```
function plot_pred_perf(pred,r_avg,r_test,test_year,custom_ylim,labe
    l = length(pred(:,1));
    cdsfe = zeros(l,2);
    prev = [0 0];
    for i = 1:l
        avg_err2 = (r_test(i)-r_avg(i))^2;
        cdsfe(i,1) = prev(1) + avg_err2 - (r_test(i) - pred(i))^2;
        cdsfe(i,2) = prev(2) + avg_err2 - (r_test(i) - max(0,pred(i)
        prev(1) = cdsfe(i,1);
        prev(2) = cdsfe(i,2);
    end
    x_year = test_year:1/12:(test_year+l/12);
    plot(x_year,zeros(length(x_year),1),'color',[0 0 0])
    plot(x_year,[0; cdsfe(:,2)],'color',[0 0 0]+0.4)
    plot(x_year,[0; cdsfe(:,1)],'color',[0 0 0])
    xlim([test_year test_year+l/12]+1/12)
    ylim(custom_ylim)
    title(label)
    set(gca, 'XTick', 1965:10:2015)
end

```

data processing

```
raw_data = xlsread('PredictorData2015.xlsx','Monthly');
label = {'A. log(DP)', 'B. log(DY)', 'C. log(EP)', 'D. log(DE)',...
    'E. SVAR', 'F. BM', 'G. NTIS', 'H. TBL',...
    'I. LTY', 'J. LTR', 'K.TMS', 'L. DFY',...
    'M. DFR', 'N. INFL'};
% starting date of monthly data Dec 1926
begin_date = 192612;
begin_idx = find(raw_data(:,1)== begin_date);
lagged_data = raw_data(begin_idx-1,:); %data at one lag
raw_data = raw_data(begin_idx:end,:);

%out of sample testing begins from Jan 1957
test_date = 195701;
test_idx = find(raw_data(:,1)==test_date);
test_year = round(test_date/100);

%NBER data indicating troughs of business cycles (after 1957)
troughs = [195708 195808; 196004 196102; 196912 197011;
    197311 197503; 198001 198007; 198107 198211; 199007 199103;
    200103 200111; 200712 200906];

%realized equity premium (excess return)
r = log(1+raw_data(:,17))-raw_data(:,11);

%predictors
log_price = log(raw_data(:,2));
log_div = log(raw_data(:,3));
log_earning = log(raw_data(:,4));
log_dp = log_div - log_price;
```

```
log_dy = log_div - [log(lagged_data(1,2)); log_price(1:end-1)];
log_ep = log_earning - log_price;
log_de = log_div - log_earning;
svar = raw_data(:,15);
bm = raw_data(:,5);
ntis = raw_data(:,10);
tbl = raw_data(:,6);
lty = raw_data(:,9);
ltr = raw_data(:,13);
tms = lty - tbl;
dfy = raw_data(:,8) - raw_data(:,7);
dfr = raw_data(:,14) - ltr;
infl = raw_data(:,12);

pred_data = zeros(length(raw_data),14);
pred_data(:,1) = log_dp;
pred_data(:,2) = log_dy;
pred_data(:,3) = log_ep;
pred_data(:,4) = log_de;
pred_data(:,5) = svar;
pred_data(:,6) = bm;
pred_data(:,7) = ntis;
pred_data(:,8) = tbl;
pred_data(:,9) = lty;
pred_data(:,10) = ltr;
pred_data(:,11) = tms;
pred_data(:,12) = dfy;
pred_data(:,13) = dfr;
pred_data(:,14) = infl;

%benchmark historical avg mkt
test_len = length(raw_data) - test_idx + 1;
r_avg = zeros(test_len,1);
prev_r_avg = mean(r(1:test_idx-1));
for i = 1:test_len
    r_avg(i) = prev_r_avg;
    prev_r_avg = (prev_r_avg*(test_idx-2+i)+...
        r(test_idx-1+i))/(test_idx-1+i);
end
```

Making predictions using predictors, and plotting

prediction performance measured by sum of squared error of ep_avg benchmark minus sse of prediction

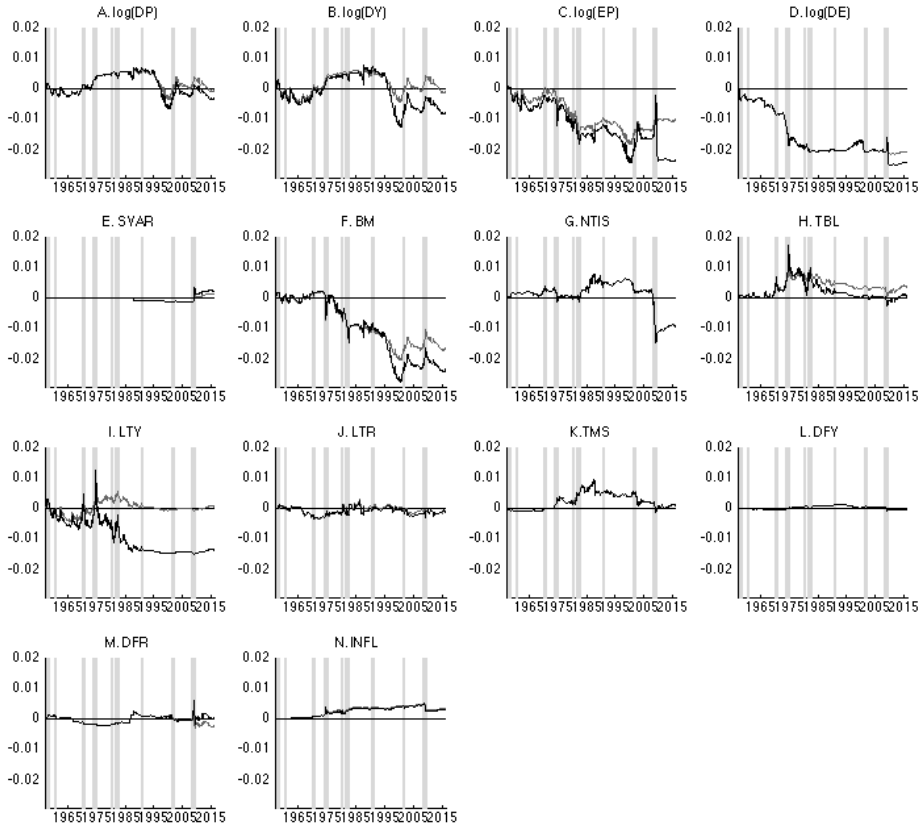
```
% actual historical equity premium
r_test = r(test_idx:end);

%initializing prediction matrix
r_pred = zeros(length(raw_data)-test_idx+1,16);

%prediction
```

```
for i = 1:14
    r_pred(:,i) = predict_r(pred_data(:,i),r,test_idx);
end
%kitchen sink pred
r_pred(:,15) = predict_r(pred_data,r,test_idx);
%pool-avg pred
r_pred(:,16) = mean(r_pred(:,1:14),2);
```

Performance of predictions of individual predictors

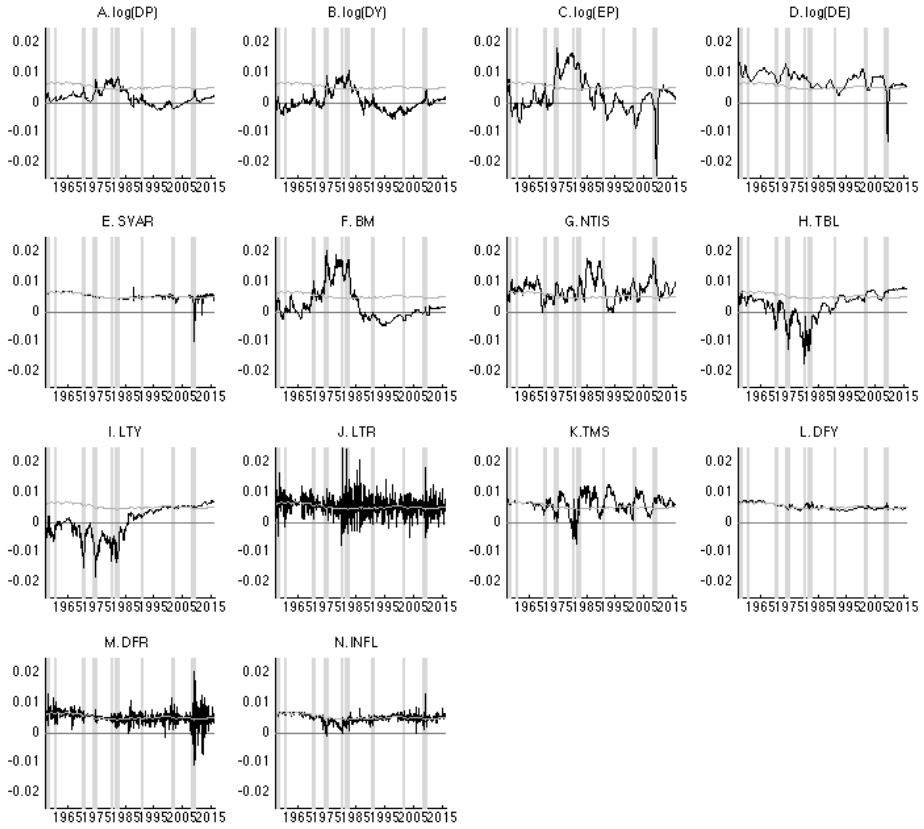
Measured by cumulative error relative to historical average prediction

```
figure(1)
set(gcf,'units','centimeters','position',[0 0 30 30])
for i = 1:14
    subplot(4,4,i)
    hold on
    plot_troughs(troughs)
    plot_pred_perf(r_pred(:,i), r_avg, r_test,test_year,[-0.029 0.02],label(i))
    hold off
end
```



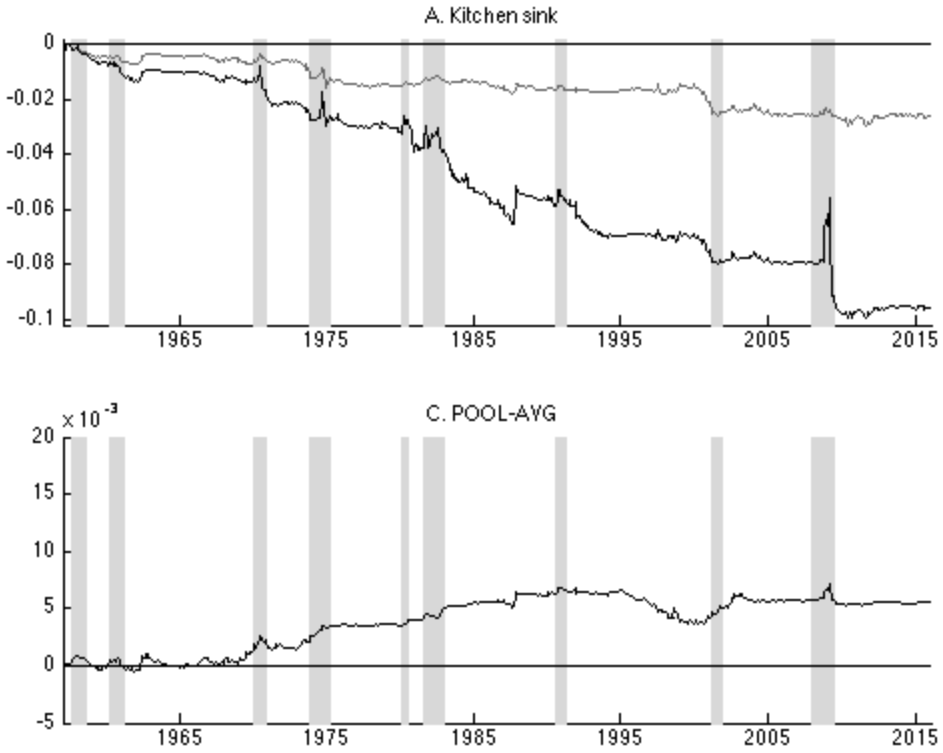
Plot of Actual predictions from individual predictors

```
figure(2)
set(gcf,'units','centimeters','position',[0 0 30 30])
for i = 1:14
    subplot(4,4,i)
    hold on
    plot_troughs(troughs)
    plot_pred(r_pred(:,i), r_avg, test_year,[-0.025,0.025],label(i))
    hold off
end
```



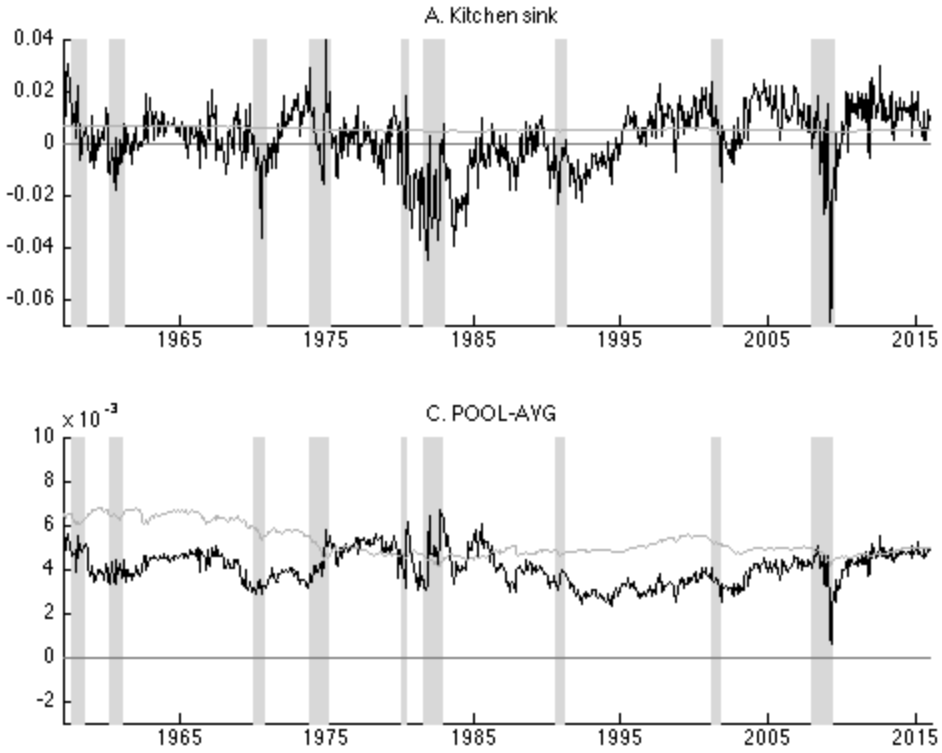
Performance of Kitchen sink and POOL-AVG predictions

```
figure(3)
subplot(2,1,1)
hold on
plot_troughs(troughs)
plot_pred_perf(r_pred(:,15), r_avg, r_test,test_year,[-0.102 0.002],'A. Kitchen si
hold off
subplot(2,1,2)
hold on
plot_troughs(troughs)
plot_pred_perf(r_pred(:,16), r_avg, r_test,test_year,[-0.005 0.02],'C. POOL-AVG')
hold off
```



Actual predictions of Kitchen sink and POOL-AVG

```
figure(4)
subplot(2,1,1)
hold on
plot_troughs(troughs)
plot_pred(r_pred(:,15),r_avg,test_year,[-0.07,0.04],'A. Kitchen sink')
hold off
subplot(2,1,2)
hold on
plot_troughs(troughs)
plot_pred(r_pred(:,16),r_avg,test_year,[-0.003,0.01],'C. POOL-AVG')
hold off
```



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