Problem Set 1

Advanced Macro

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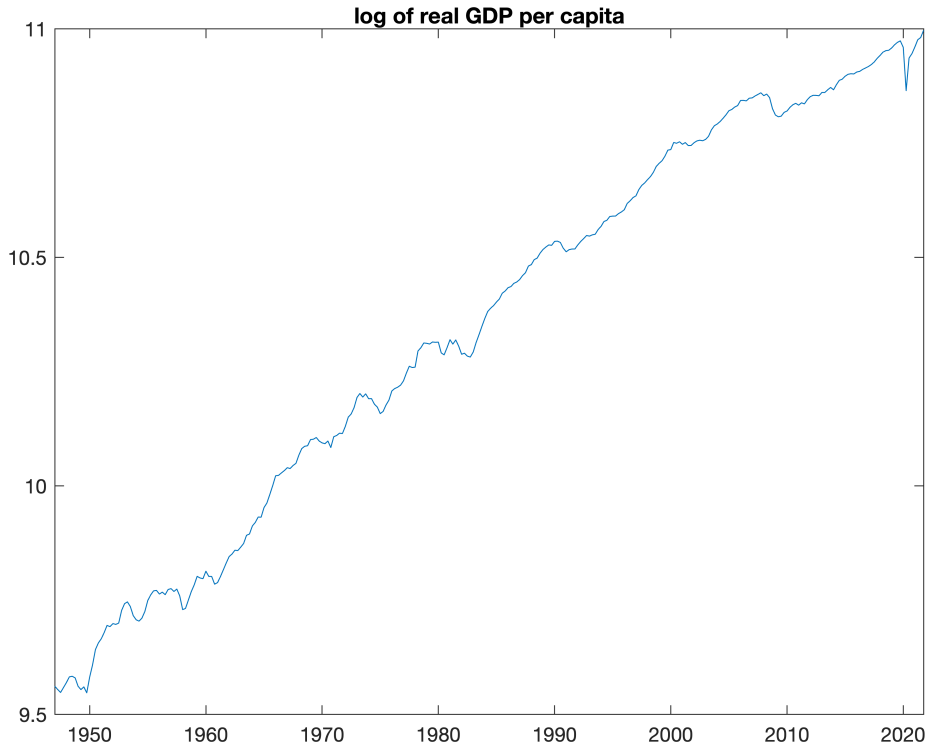
```
clear
clc
close all
```

Q1.

Download the series of US real per capita GDP from 1947:I to 2021:IV. Graph the series in logs.

```
url = 'https://fred.stlouisfed.org/';
c = fred(url);
series = 'A939RX0Q048SBEA'; % Real GDP per capita
start_date = '1947-01-01';
end_date = '2021-10-01';
d = fetch(c,series,start_date,end_date);

date = datetime(d.Data(:,1),'ConvertFrom','datenum');
y = log(d.Data(:,2)); % in logs
```

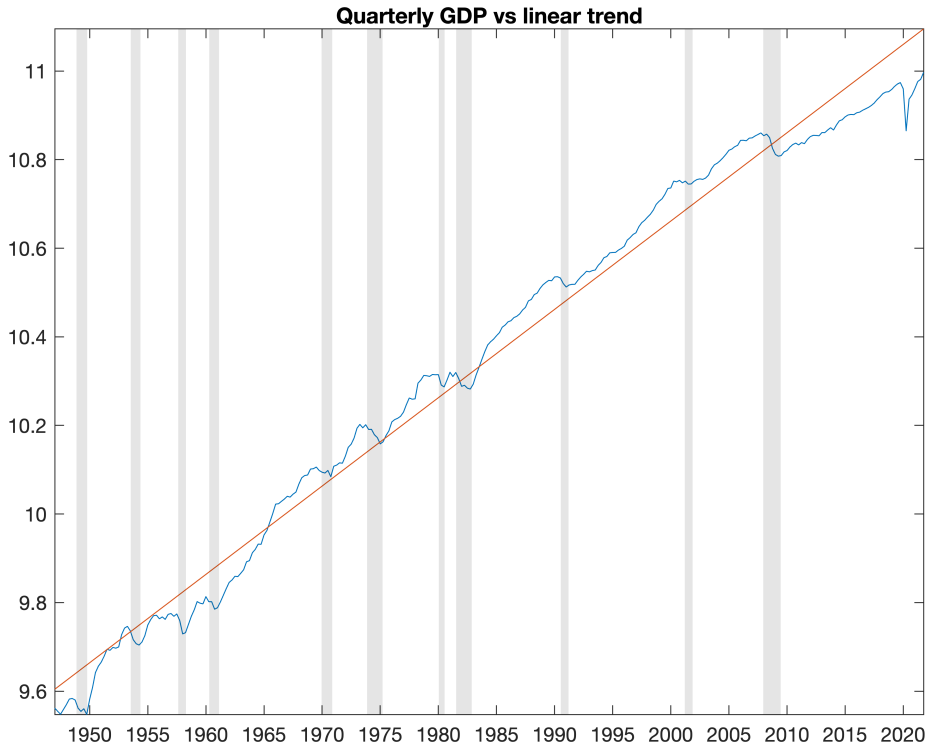
```
figure;plot(date,y)
title('log of real GDP per capita')
```



Q2.

Extract a linear trend from the log output series and plot the result

```
yc_linear = detrend(y);
yg_linear = y - yc_linear;

figure;
plot(date,y)
hold on
plot(date,yg_linear)
datetick('x','yyyy');
axis tight
recessionplot;
title('Quarterly GDP vs linear trend')
```



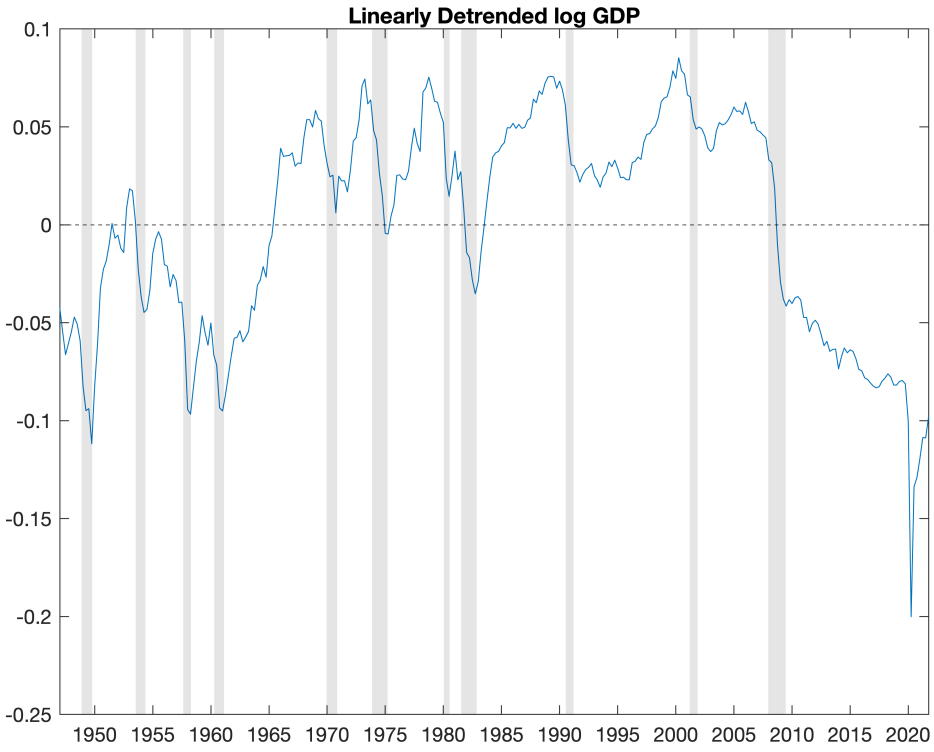
Compute the resulting average growth rate of per capita GDP.

```
gr_yg_linear = 400*(yg_linear(2)-yg_linear(1)) % LR growth rate (annualized %)
```

```
gr_yg_linear = 1.9941
```

Compute the cyclical component (the residuals) and plot them.

```
figure;
plot(date,yc_linear)
yline(0,'k--')
recessionplot;
datetick('x','yyyy');
axis tight
title('Linearly Detrended log GDP')
```



Compute the sample standard deviations and the first sample autocorrelation of the cyclical component.

```
std_yc_linear = 100*std(yc_linear) % standard deviation
```

```
std_yc_linear = 5.4831
```

```
Nlag = 1;
[Acf_yc_linear,~,~] = autocorr(yc_linear,'NumLags',Nlag);
Acf_yc_linear(2) % first sample autocorrelation
```

```
ans = 0.9715
```

Do you think linear detrending is adequate? Explain.

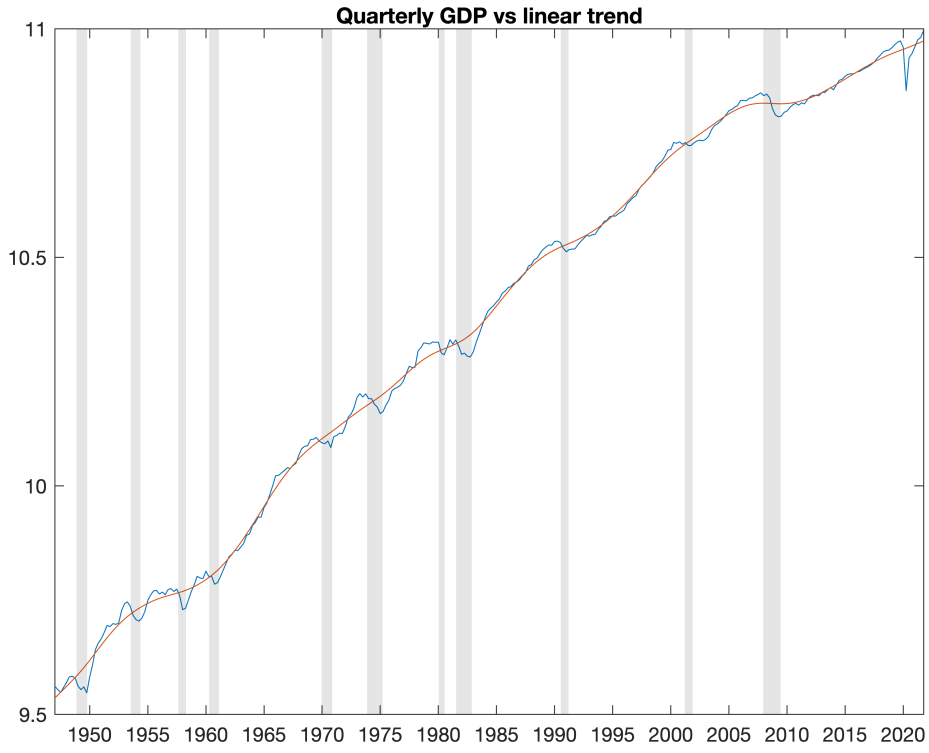
No. The cyclical compotent deviates too much from its mean especially after 2009.

Q3.

Obtain the HP filttered series for output (set = 1600). Plot the HP trend and the log GDP series.

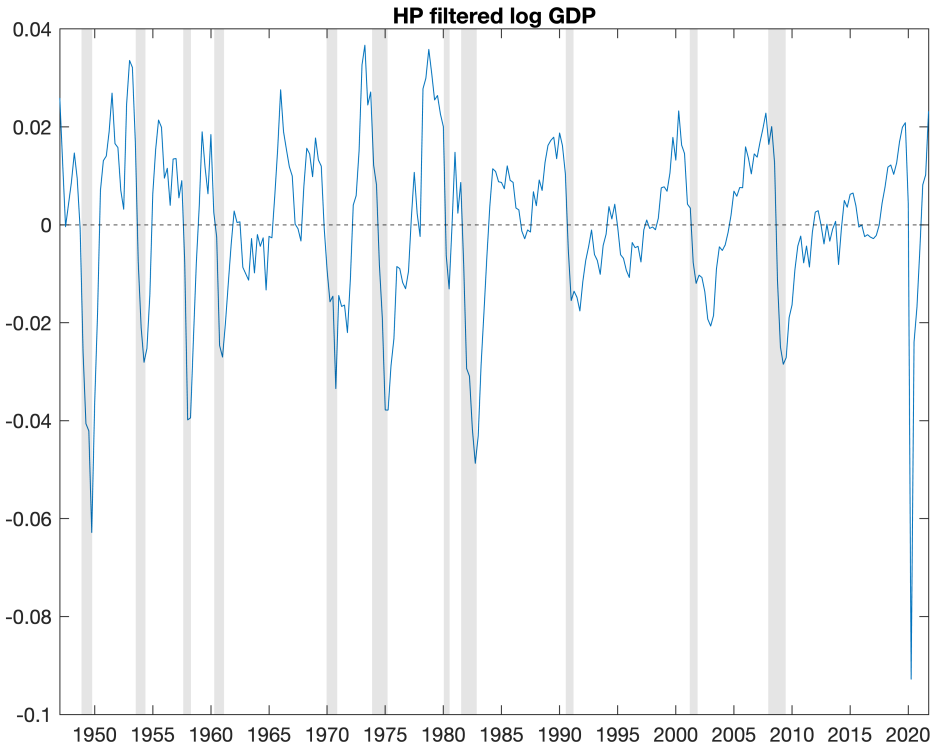
```
[yg_hp, yc_hp] = hpfilter(y,1600);

figure;
plot(date,y)
hold on
```

```
plot(date,yg_hp)
recessionplot;
datetick('x','yyyy');
axis tight
title('Quarterly GDP vs linear trend')
```



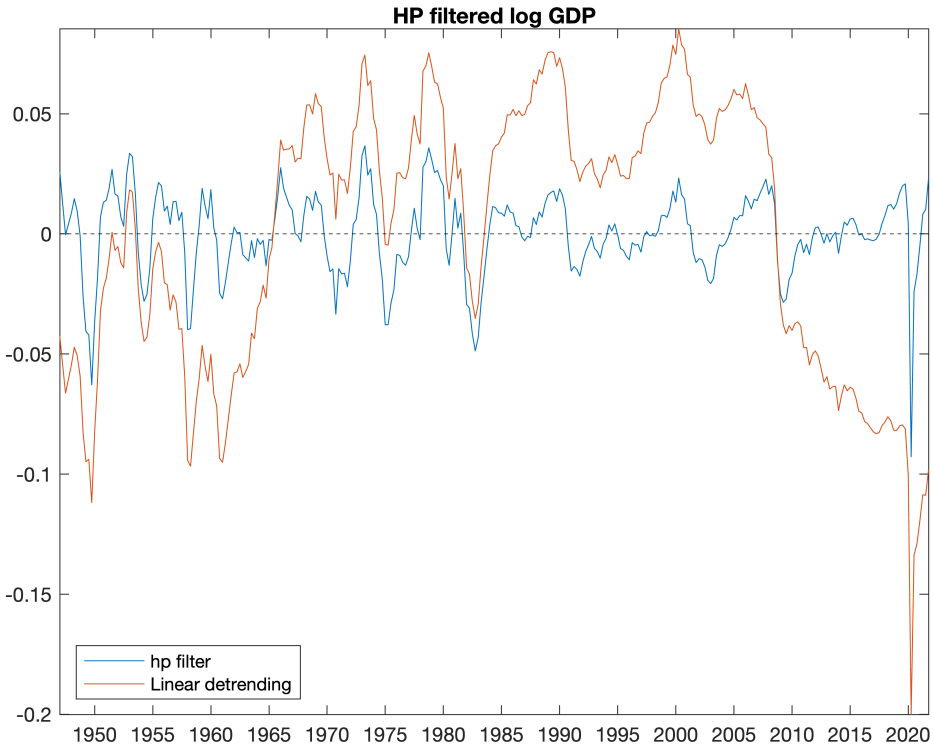
Compute the resulting cyclical component and plot it.

```
figure;
plot(date,yc_hp)
yline(0,'k--')
recessionplot;
datetick('x','yyyy');
axis tight
title('HP filtered log GDP')
```



Compare the plot against the corresponding one in the previous question.

```
figure;
plot(date,yc_hp)
hold on
plot(date,yc_linear)
yline(0,'k--')
datetick('x','yyyy');
axis tight
legend('hp filter','Linear detrending','location','southwest')
title('HP filtered log GDP')
```



Finally, obtain the sample standard deviation and the first eight autocorrelations of the HP filltered cyclical component.

```
std_yc_hp = 100*std(yc_hp) % standard deviation
```

```
std_yc_hp = 1.6946
```

```
Nlag = 8;
[Acf_yc_hp,Lags,~] = autocorr(yc_hp,'NumLags',Nlag);

Acf_yc_hp(2:end)
```

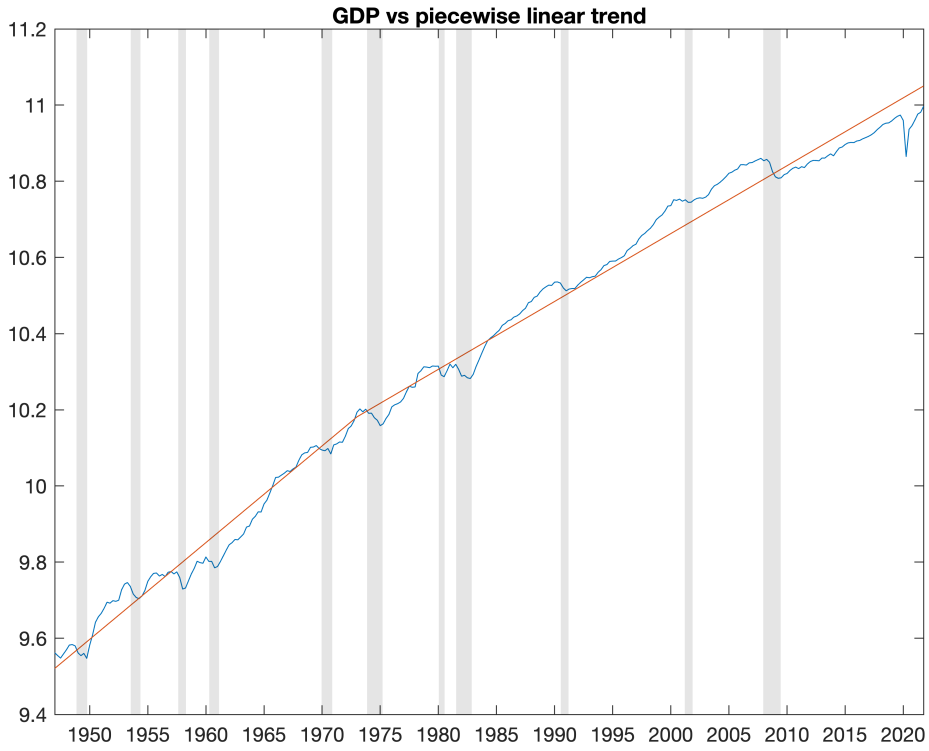
```
ans = 8×1
    0.7770
    0.5403
    0.2854
    0.0649
   -0.0907
   -0.1905
   -0.2264
   -0.2494
```

Q4.

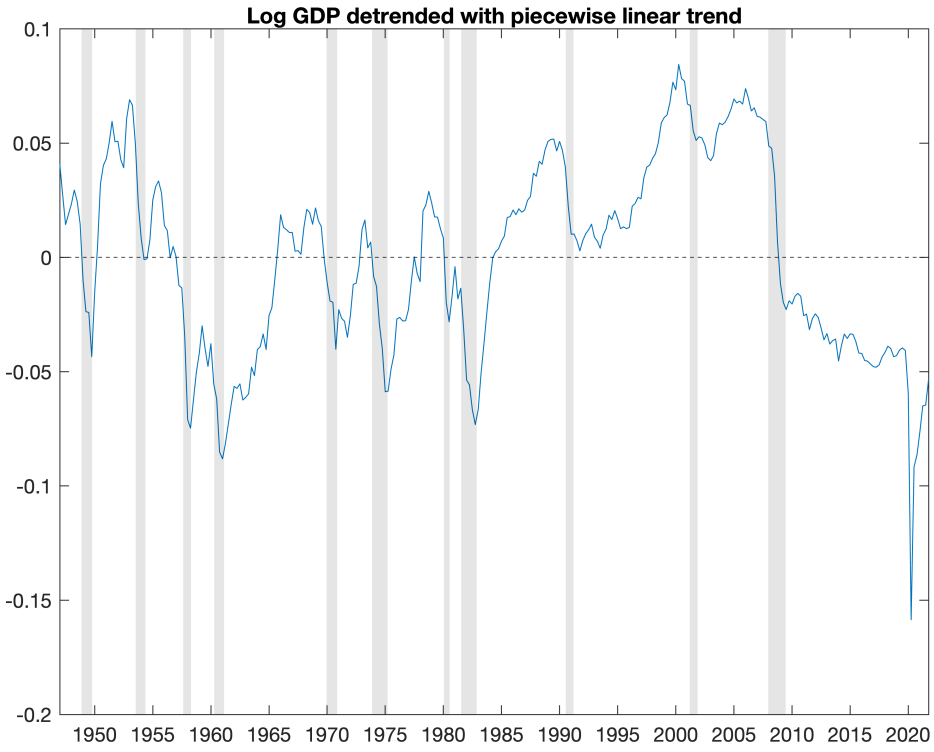
Do the same as in question 2, but allow for a break in the growth rate in 1973:I.

```
% linear detrending w/ break at 1973Q1
idx_break = find(date == '01-Jan-1973');
yc_linear_break = detrend(y,1,idx_break);
```

```
yg_linear_break = y - yc_linear_break;

figure;
plot(date,y)
hold on
plot(date,yg_linear_break)
recessionplot;
datetick('x','yyyy');
axis tight
title('GDP vs piecewise linear trend')
```




```
figure;
plot(date,yc_linear_break)
yline(0,'k--')
recessionplot;
datetick('x','yyyy');
axis tight
title('Log GDP detrended with piecewise linear trend')
```




```
std_yc_linear_break = 100*std(yc_linear_break) % standard deviation
```

```
std_yc_linear_break = 4.1731
```

```
Nlag = 1;
[Acf_yc_linear_break,~,~] = autocorr(yc_linear_break,'NumLags',Nlag);
Acf_yc_linear_break(2) % first sample autocorrelation
```

```
ans = 0.9576
```

```
gr_yg_ilnear_break = [400*(yg_linear_break(2)-yg_linear_break(1));...
    400*(yg_linear_break(end)-yg_linear_break(end-1))] % LR growth rate (annualized %)
```

```
gr_yg_ilnear_break = 2×1
    2.5404
    1.7822
```

The long-run growth declined after the break point.