

Advanced Macroeconomics II

Problem Set 7—Detrending and Calibration

ANS 1 *Imported the RBC data to matlab*

See the script.

ANS 2 *Take log of each original data and plot them in a graph like Figure 3.1 on page 33 of Dave & Dejong (2007).*

See Figure 1.

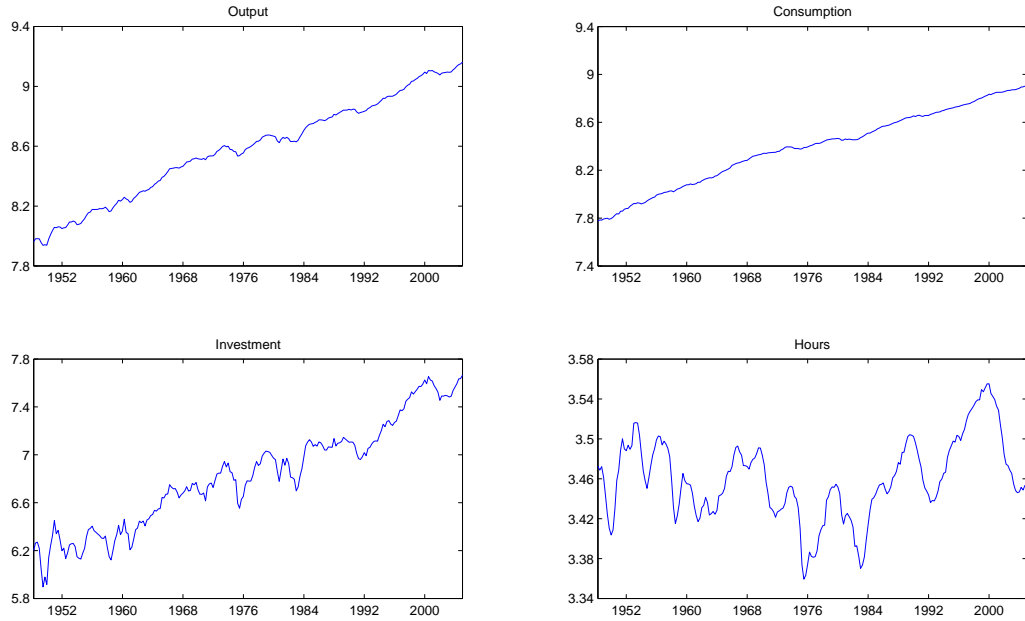


Figure 1: Logged Trajectories of Business Cycle Data

ANS 3 *Remove a linear trend*

By OLS, we can calculate that $\hat{\alpha}_0^1 = 7.9672$, $\hat{\alpha}_0^2 = 7.7748$, $\hat{\alpha}_0^3 = 6.2150$, $\hat{\alpha}_1^1 = \hat{\alpha}_1^2 = \hat{\alpha}_1^3 = 0.0054$. Note that the first entry was assume to take $t = 0$ (if the first entry corresponds to $t = 1$, then minus all the $\hat{\alpha}_0^j$ by $\hat{\alpha}_1$). See Figure 2.

ANS 4 *Remove trend by differencing.*

Note that the trend is hardly distinguishable from the original data. By OLS, $\hat{\gamma} = 0.0056$. See Figure 3.

ANS 5 *Remove a linear trend*

See Figure 4.

ANS 6 *Comparing detrended investment by the above three methods.*

See Figure 5 and 6. The correlations are:

corr	Differencing	H-P filtered
Linear	0.11342	0.21061
Differencing		0.27697

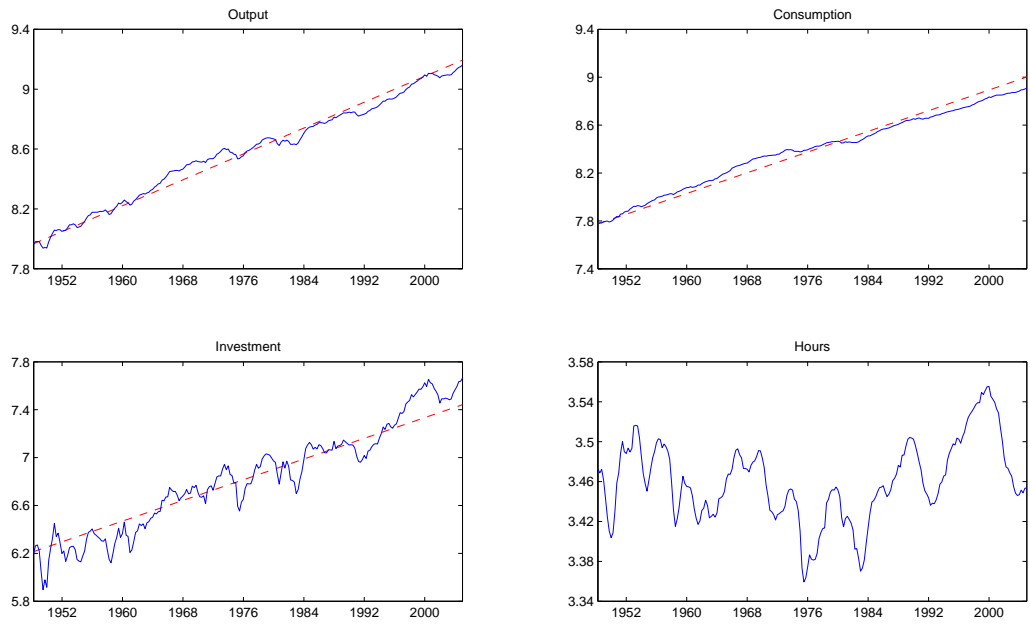


Figure 2: Logged Trajectories and a Common Linear Trend

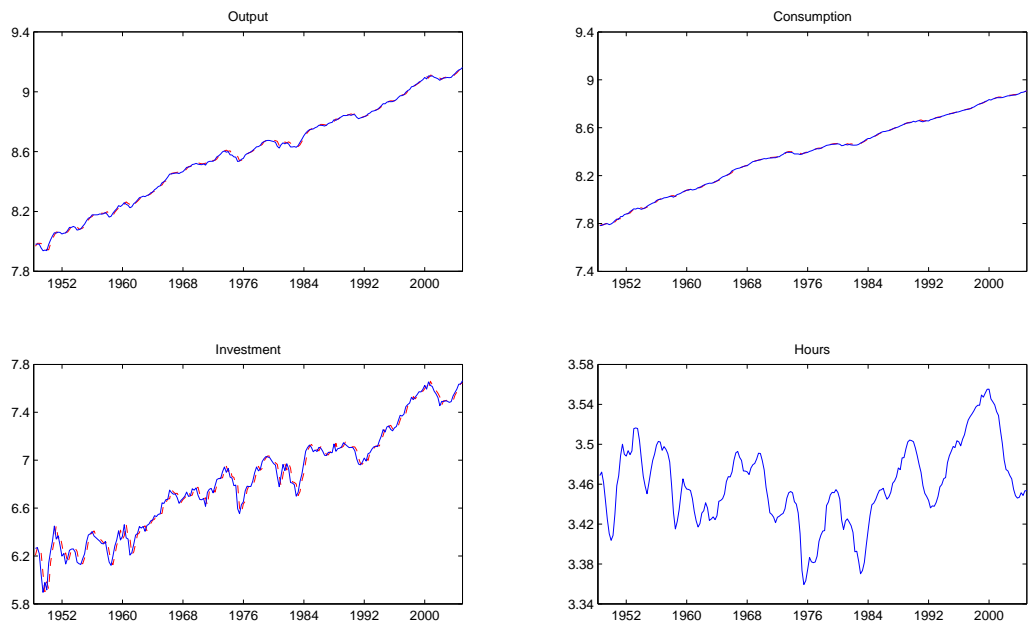


Figure 3: Logged Trajectories and a Common Growth Rate (Differencing Trends)

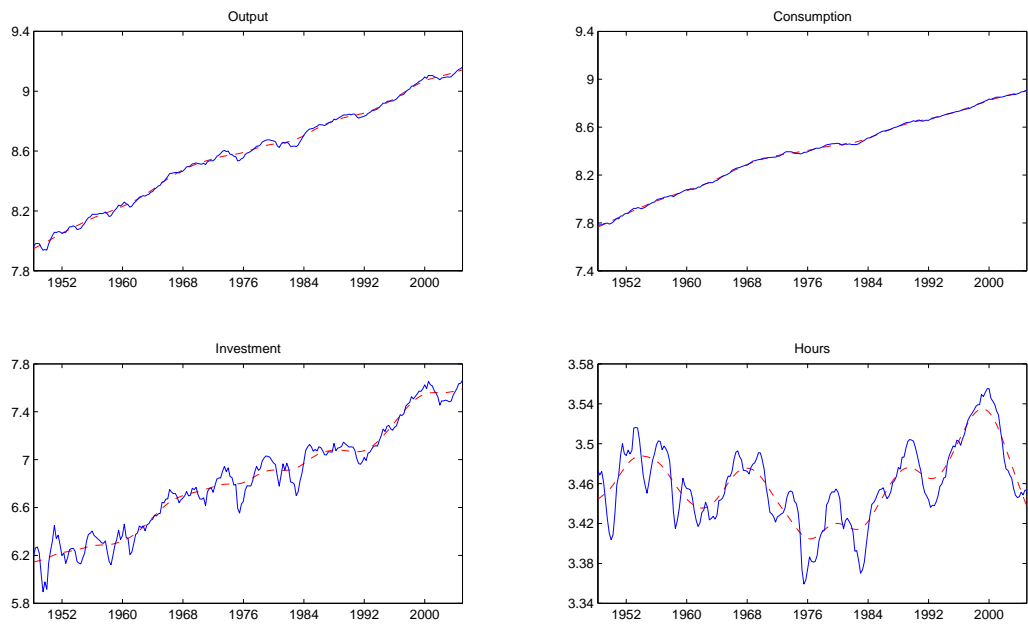


Figure 4: Logged Trajectories and H-P Trend

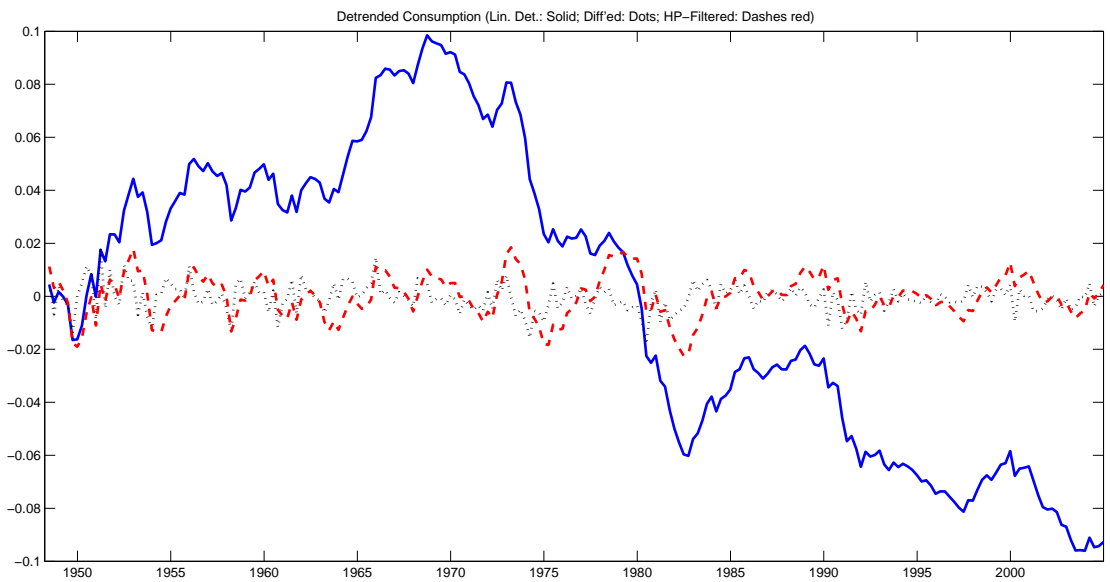


Figure 5: The detrended consumption by the three methods

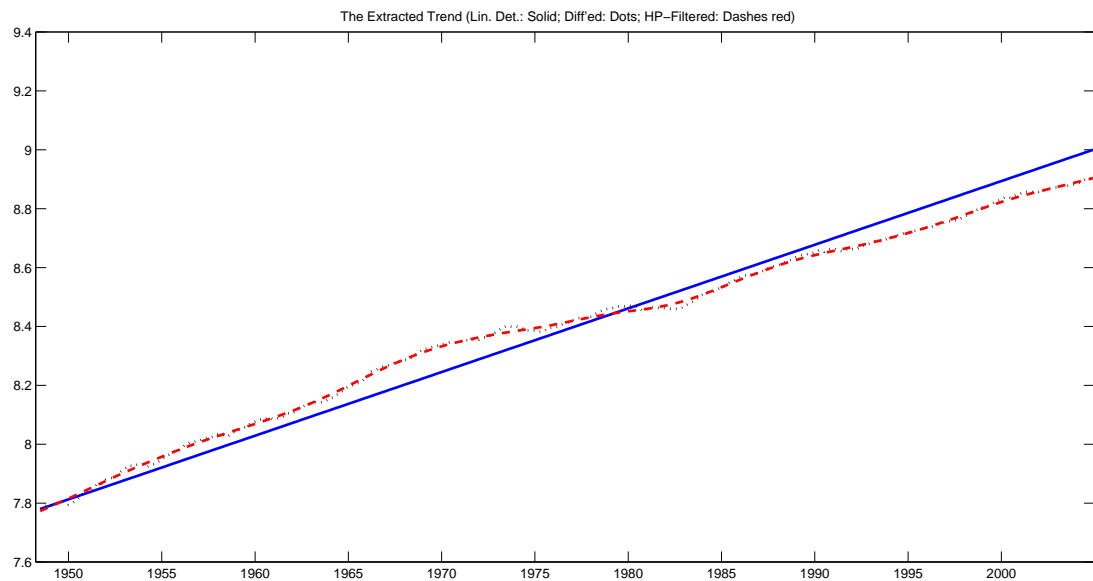


Figure 6: The extracted trend by the three methods

```

1  clear
2
3  %----- ANS 1 -----
4  % data description --- http://www.econ.pitt.edu/dbook/code/ycih_readme.txt
5  % data downloaded from --- http://www.econ.pitt.edu/dbook/code/ycih.txt
6  % load the dataset into MATLAB
7  load ycih.txt;
8
9  % copy the four columns into four series respectively
10 % all variables are in per capita terms
11 Y = ycih(:,1); % output
12 C = ycih(:,2); % consumption
13 I = ycih(:,3); % investment
14 H = ycih(:,4); % hours
15
16 % generate the TIME vector
17 time = [1948.24:0.25:2005]';
18
19 %----- ANS 2 -----
20 % taking logs of all series
21 y = log(Y);
22 c = log(C);
23 i = log(I);
24 h = log(H);
25
26 % Plot the Business Cycle Data
27 % Business Cycle Data in DeJong (2007), p. 33
28 figure(1)
29
30 subplot(2,2,1)
31 plot(time,y);
32 xlim([min(time) max(time)])

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33 ylim([7.8 9.4])
34 set(gca,'xtick',[1952:8:2000])
35 set(gca,'ytick',[7.8:0.4:9.4])
36 title('Output');
37
38 subplot(2,2,2)
39 plot(time,c);
40 xlim([min(time) max(time)])
41 ylim([7.4 9.4])
42 set(gca,'xtick',[1952:8:2000])
43 set(gca,'ytick',[7.4:0.4:9.4])
44 title('Consumption');
45
46 subplot(2,2,3)
47 plot(time,i);
48 xlim([min(time) max(time)])
49 ylim([5.8 7.8])
50 set(gca,'xtick',[1952:8:2000])
51 set(gca,'ytick',[5.8:0.4:7.8])
52 title('Investment');
53
54 subplot(2,2,4)
55 plot(time,h);
56 xlim([min(time) max(time)])
57 ylim([3.34 3.58])
58 set(gca,'xtick',[1952:8:2000])
59 set(gca,'ytick',[3.34:0.04:3.58])
60 title('Hours');
61
62 %----- ANS 3 -----
63 % Remove the Trend
64 % Fit a linear model  $\log y(t) = \alpha_0 + \alpha_1 * t + u(t)$ 
65 %  $u(t)$  is covariance stationary stochastic process
66 % output, consumption and investment share a common trend
67 nnA = length(y);
68 TTA = [0:nnA-1]';
69 % explained variables
70 YYA = [y; c; i];
71 % explanatory variables XX - constant and time
72 % XX is 3nn by 4 matrix
73 XX1 = kron(eye(3), ones(nnA,1));
74 XX2 = kron(ones(3,1),TTA);
75 XXA = cat(2, XX1, XX2);
76 % BETA is 5 by 1 coefficient vector
77 BETAA = inv(XXA'*XXA)*XXA'*YYA;
78 YYAHAT = XXA*inv(XXA'*XXA)*XXA'*YYA;
79 UUA = YYA - YYAHAT;
80
81 % Show the fitted coefficients
82 disp('alpha_0^1 is '), disp(BETAA(1))
83 disp('alpha_0^2 is '), disp(BETAA(2))
84 disp('alpha_0^3 is '), disp(BETAA(3))
85 disp('alpha_1^1 = alpha_1^2 = alpha_1^3 is '), disp(BETAA(4))
86
87 % Obtained the detrended series
88 ydr = YYAHAT(1:nnA,:);
89 cdr = YYAHAT((nnA+1):(2*nnA),:);

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90  idr = YYAHAT((2*nnA+1):(3*nnA),:);
91
92  % Plot the detrended Business Cycle Data
93  figure(2)
94
95  subplot(2,2,1)
96  plot(time,ydr,'--r');
97  hold on
98  plot(time,y);
99  hold off
100 xlim([min(time) max(time)])
101 ylim([7.8 9.4])
102 set(gca,'xtick',[1952:8:2000])
103 set(gca,'ytick',[7.8:0.4:9.4])
104 title('Output');
105
106 subplot(2,2,2)
107 plot(time,cdr,'--r');
108 hold on
109 plot(time,c);
110 hold off
111 xlim([min(time) max(time)])
112 ylim([7.4 9.4])
113 set(gca,'xtick',[1952:8:2000])
114 set(gca,'ytick',[7.4:0.4:9.4])
115 title('Consumption');
116
117 subplot(2,2,3)
118 plot(time,idr,'--r');
119 hold on
120 plot(time, i);
121 hold off
122 xlim([min(time) max(time)])
123 ylim([5.8 7.8])
124 set(gca,'xtick',[1952:8:2000])
125 set(gca,'ytick',[5.8:0.4:7.8])
126 title('Investment');
127
128 subplot(2,2,4)
129 plot(time, h);
130 xlim([min(time) max(time)])
131 ylim([3.34 3.58])
132 set(gca,'xtick',[1952:8:2000])
133 set(gca,'ytick',[3.34:0.04:3.58])
134 title('Hours');
135
136 %----- ANS 4 -----
137 % Data are generated by
138 %  $\log y(t) = \log y(0) + \epsilon(t)$ 
139 %  $\epsilon(t) = \gamma + \epsilon(t-1) + u(t)$ 
140 % Doing differencing
141 ydif = diff(y);
142 cdif = diff(c);
143 idif = diff(i);
144
145 nnB = length(ydif);
146 YYB = [ydif; cdif; idif];

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```

147 XXB = ones(3*nnB, 1);
148 BETAB = inv(XXB'*XXB)*XXB'*YYB;
149 YYBHAT = XXB*inv(XXB'*XXB)*XXB'*YYB;
150 UUB = YYB - YYBHAT;
151
152 disp('gamma is'), disp(BETAB)
153
154 ydif1 = y(1:end-1) + BETAB(1);
155 cdif1 = c(1:end-1) + BETAB(1);
156 idif1 = i(1:end-1) + BETAB(1);
157 % Estimate the common trend according to the
158 % restricted constraint
159 % Plot the differenced Business Cycle Data
160 figure(3)
161
162 subplot(2,2,1)
163 plot(time(2:end),ydif1,'--r');
164 hold on
165 plot(time(2:end),y(2:end));
166 hold off
167 xlim([min(time) max(time)])
168 ylim([7.8, 9.4])
169 set(gca,'xtick',[1952:8:2000])
170 set(gca,'ytick',[7.8:0.4:9.4])
171 title('Output');
172
173 subplot(2,2,2)
174 plot(time(2:end),cdif1,'--r');
175 hold on
176 plot(time(2:end),c(2:end));
177 hold off
178 xlim([min(time) max(time)])
179 ylim([7.4 9.4])
180 set(gca,'xtick',[1952:8:2000])
181 set(gca,'ytick',[7.4:0.4:9.4])
182 title('Consumption');
183
184 subplot(2,2,3)
185 plot(time(2:end),idif1,'--r');
186 hold on
187 plot(time(2:end), i(2:end));
188 hold off
189 xlim([min(time) max(time)])
190 ylim([5.8 7.8])
191 set(gca,'xtick',[1952:8:2000])
192 set(gca,'ytick',[5.8:0.4:7.8])
193 title('Investment');
194
195 subplot(2,2,4)
196 plot(time(2:end), h(2:end));
197 xlim([min(time) max(time)])
198 ylim([3.34 3.58])
199 set(gca,'xtick',[1952:8:2000])
200 set(gca,'ytick',[3.34:0.04:3.58])
201 title('Hours');
202
203 %----- ANS 5 -----

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204 % Remove trend by H-P filter.
205 % [y_hpcycle; y_hptrend] = HP_filter_fun(y; lambda)
206 lambda = 1600; % setting lambda
207 [y_hpcycle, y_hptrend] = HP_filter_fun(y, lambda);
208 [c_hpcycle, c_hptrend] = HP_filter_fun(c, lambda);
209 [i_hpcycle, i_hptrend] = HP_filter_fun(i, lambda);
210 [h_hpcycle, h_hptrend] = HP_filter_fun(h, lambda);
211
212 % Plot the H-P trends
213 figure(4)
214
215 subplot(2,2,1)
216 %plot(time,y_hpcycle,'--r');
217 %hold on
218 plot(time, y_hptrend,'--r');
219 hold on
220 plot(time,y);
221 hold off
222 xlim([min(time) max(time)])
223 ylim([7.8, 9.4])
224 set(gca,'xtick',[1952:8:2000])
225 set(gca,'ytick',[7.8:0.4:9.4])
226 title('Output');
227
228 subplot(2,2,2)
229 %plot(time,c_hpcycle,'--r');
230 %hold on
231 plot(time,c_hptrend,'--r');
232 hold on
233 plot(time, c);
234 hold off
235 xlim([min(time) max(time)])
236 ylim([7.4 9.4])
237 set(gca,'xtick',[1952:8:2000])
238 set(gca,'ytick',[7.4:0.4:9.4])
239 title('Consumption');
240
241 subplot(2,2,3)
242 %plot(time,i_hpcycle,'--r');
243 %hold on
244 plot(time,i_hptrend,'--r');
245 hold on
246 plot(time, i);
247 hold off
248 xlim([min(time) max(time)])
249 ylim([5.8 7.8])
250 set(gca,'xtick',[1952:8:2000])
251 set(gca,'ytick',[5.8:0.4:7.8])
252 title('Investment');
253
254 subplot(2,2,4)
255 plot(time, h_hptrend,'--r');
256 hold on
257 plot(time, h)
258 hold off
259 xlim([min(time) max(time)])
260 ylim([3.34 3.58])

```



```

261 set(gca,'xtick',[1952:8:2000])
262 set(gca,'ytick',[3.34:0.04:3.58])
263 title('Hours');
264
265 %----- ANS 6 -----
266 % Plot the cyclical components of consumption (logged consumption minus the
267 % estimated trend) from the three methods
268 % (1) time trend
269 % (2) differencing
270 % (3) H-P filter
271
272 % Calculate the detrended consumption
273
274 c_timedetrend = UUA(nnA+1:nnA*2);
275 c_differenced = UUB(nnB+1:nnB*2);
276 c_HP = c - c_hptrend;
277
278 % Plot detrended investment
279 figure(5)
280 plot(time(2:end), c_timedetrend(2:end),'LineWidth',2);
281 hold on
282 plot(time(2:end), c_differenced,':k','LineWidth',2);
283 hold on
284 plot(time(2:end), c_HP(2:end),'--r','LineWidth',2);
285 xlim([min(time), max(time)])
286 hold off
287 title('Detrended Consumption (Lin. Det.: Solid; Diff''ed: Dots; HP-Filtered: Dashes red)')
288
289 % Calculate the trends
290 c_timetrend = BETAA(2)+BETAA(4)*TTA;
291 c_difftrend = c(1:end-1) + BETAB;
292 c_HPtrend = c_hptrend;
293
294 % Plot the trends extracted
295 figure(6)
296 plot(time(2:end), c_timetrend(2:end),'LineWidth',2);
297 hold on
298 plot(time(2:end), c_difftrend, ':k','LineWidth',2);
299 hold on
300 plot(time(2:end), c_HPtrend(2:end),'--r', 'LineWidth',2 );
301 xlim([min(time), max(time)])
302 hold off
303 title('The Extracted Trend (Lin. Det.: Solid; Diff''ed: Dots; HP-Filtered: Dashes red)')
304
305 % Calculate the correlation
306 corr1=corr(c_timedetrend(2:end), c_differenced);
307 corr2=corr(c_differenced, c_HP(2:end));
308 corr3=corr(c_timedetrend(2:end), c_HP(2:end));
309
310
311 display(char(['corr','          Differenced','          H-P filtered']))
312 display(char(['Linear','          ',num2str(corr1), '          ',num2str(corr3)]))
313 display(char(['Differenced','          ',num2str(corr2)]))

```
