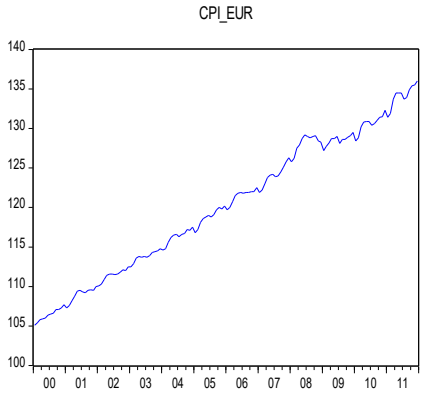
Test Exercise 6

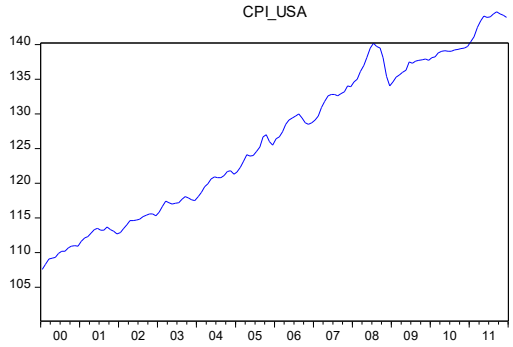
(a) Make time series plots of the CPI of the Euro area and the USA, and also of their logarithm log(CPI) and of the two monthly inflation series DP=Δlog(CPI). What conclusions do you draw from these plots?

CPI plots of both EUR & USA are non stationary & show linear trends, there could be a structural break with US data

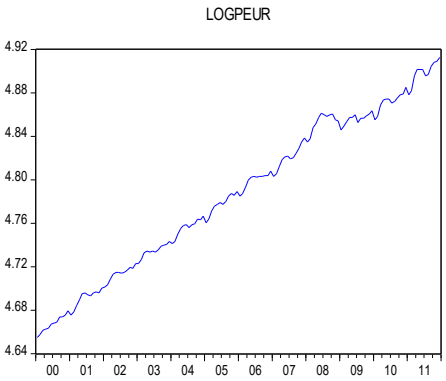
The two DP series do not seem to have a constant variance, thus they can't be strictly called stationary, though the mean of the trend seems constant. The variance is increasing for EUR, while the increase is not as much for USA, except for 1 aberration.

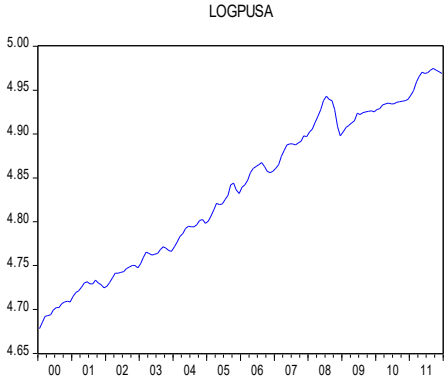
CPI_EUR & CPI_USA



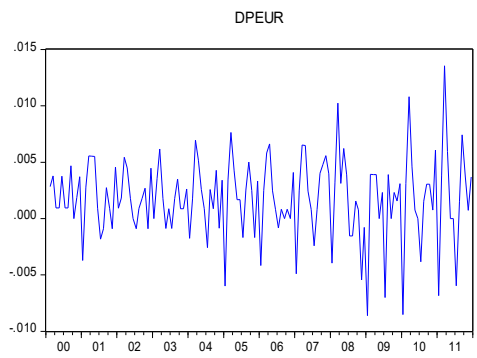


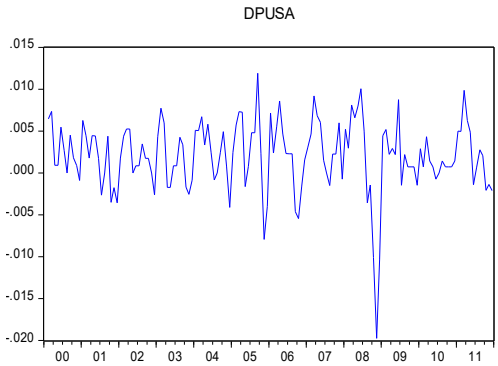
Log CPI_EUR & Log CPI_USA





DPEUR & DPUSA





(b) Perform the Augmented Dickey-Fuller (ADF) test for the two log(CPI) series. In the ADF test equation, include a constant (α), a deterministic trend term (βt), three lags of DP=Δlog(CPI) and, of course, the variable of interest log(CPI_{t-1}). Report the coefficient of log(CPI_{t-1}) and its standard error and t-value, and draw your conclusion.

Note: The answer below is only for the restricted sample as given in instructions. ADF for full sample is calc after this.

ADF for log CPI_EUR

Variable	Coefficient	Std. Error	t-Statistic
C	0.558895	0.226664	2.465742
TREND	0.000205	8.62E-05	2.379605
LOGPEUR(-1)	-0.119524	0.048693	-2.454653
DPEUR(-1)	0.134341	0.09171	1.464845
DPEUR(-2)	-0.041032	0.090756	-0.452116
DPEUR(-3)	-0.127022	0.091258	-1.391907

coefficient of log(CPI_{t-1}): -0.12
Std error of coefficient of log(CPI_{t-1}): 0.05
t value of coefficient of log(CPI_{t-1}): -2.45

Conclusion: series is non stationary - the test statistic for ADF is -2.45, so > -3.5, so H_0 of non stationarity is accepted.

ADF for log CPI_USA

Variable	Coefficient	Std. Error	t-Statistic
C	0.333672	0.138134	2.415573
TREND	0.000146	6.36E-05	2.287603
LOGPUSA(-1)	-0.070983	0.029537	-2.403149
DPUSA(-1)	0.607723	0.088557	6.862541
DPUSA(-2)	-0.168416	0.10097	-1.667982
DPUSA(-3)	0.007981	0.091116	0.087592

coefficient of log(CPI_{t-1}): -0.07
Std error of coefficient of log(CPI_{t-1}): 0.03
t value of coefficient of log(CPI_{t-1}): -2.40

Conclusion: series is non stationary - the test statistic for ADF is -2.40, so > -3.5, so H_0 of non stationarity is accepted.

ADF for full sample: conclusions – same as

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.642038	0.226321	2.836853	0.0053
TREND	0.000237	8.50E-05	2.794616	0.006
LOGPEUR(-1)	-0.137373	0.048605	-2.826294	0.0054
DPEUR(-1)	0.144245	0.086654	1.664611	0.0983
DPEUR(-2)	-0.090217	0.085209	-1.058773	0.2916
DPEUR(-3)	-0.112803	0.085654	-1.316964	0.1901

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.349441	0.127207	2.747018	0.0068
TREND	0.000151	5.72E-05	2.645148	0.0091
LOGPUSA(-1)	-0.074337	0.027185	-2.734473	0.0071
DPUSA(-1)	0.609115	0.084043	7.247694	0
DPUSA(-2)	-0.151264	0.096499	-1.567518	0.1194
DPUSA(-3)	-0.006444	0.086228	-0.074734	0.9405

(c) As the two series of log(CPI) are not cointegrated (you need not check this), we continue by modelling the monthly inflation series DPEUR = Δlog(CPIEUR) for the Euro area. Determine the sample autocorrelations and the sample partial autocorrelations of this series to motivate the use of the following ARmodel: $DPEURt = \alpha+\beta_1 DPEUR_{t-6}+\beta_2 DPEUR_{t-12}+\varepsilon_t$. Estimate the parameters of this model (sampleJan2000-Dec2010).

In the following regression results, only lags 6 and lags 12 are significant. The other lags are also determined to be not jointly significant

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.001307	0.000646	2.021522	0.0457
DPEUR(-1)	0.055916	0.084874	0.658808	0.5114
DPEUR(-2)	0.001922	0.084792	0.022671	0.982
DPEUR(-3)	-0.115232	0.084437	-1.364702	0.1752
DPEUR(-4)	0.009266	0.085475	0.108403	0.9139
DPEUR(-5)	-0.135961	0.084037	-1.617857	0.1087
DPEUR(-6)	0.181756	0.084779	2.143875	0.0343
DPEUR(-7)	-0.060114	0.085091	-0.706468	0.4814
DPEUR(-8)	-0.126811	0.084069	-1.508412	0.1344
DPEUR(-9)	-0.006681	0.084898	-0.078696	0.9374
DPEUR(-10)	-0.104855	0.087307	-1.200994	0.2324
DPEUR(-11)	0.016168	0.087711	0.18433	0.8541
DPEUR(-12)	0.534684	0.091193	5.863186	0

Also confirmed by,

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.083	0.083	0.9289	0.335
		2	-0.109	-0.117	2.5384	0.281
		3	-0.199	-0.183	7.9330	0.047
		4	-0.159	-0.148	11.400	0.022
		5	-0.088	-0.120	12.482	0.029
		6	0.403	0.374	35.109	0.000
		7	-0.035	-0.195	35.282	0.000
		8	-0.173	-0.166	39.535	0.000
		9	-0.162	-0.068	43.285	0.000
		10	-0.111	-0.076	45.072	0.000
		11	0.015	0.042	45.103	0.000
		12	0.554	0.398	90.116	0.000

Parameters of the ARmodel: $DPEURt = \alpha+\beta_1 DPEUR_{t-6}+\beta_2 DPEUR_{t-12}+\varepsilon_t$.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000384	0.000281	1.364955	0.1749
DPEUR(-6)	0.18875	0.077289	2.442129	0.0161
DPEUR(-12)	0.59798	0.083555	7.156751	0

A = 0
β_1 = 0.19
β_2 = 0.60

(d) Extend the AR model of part (c) by adding lagged values of monthly inflation in the USA at lags 1, 6, and 12. Check that the coefficient at lag 6 is not significant, and estimate the ADL model $DPEURt = \alpha+\beta_1 DPEUR_{t-6} +\beta_2 DPEUR_{t-12} +\gamma_1 DPUSA_{t-1} +\gamma_2 DPUSA_{t-12} +\varepsilon_t$

Adding DPUSA at lags 1,6 and 12 to the AR model in the prev Q

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000441	0.000285	1.544524	0.1253
DPEUR(-6)	0.202983	0.078553	2.584012	0.011
DPEUR(-12)	0.636756	0.087478	7.279009	0
DPUSA(-1)	0.22643	0.05113	4.428527	0
DPUSA(-6)	-0.056049	0.054767	-1.02342	0.3083
DPUSA(-12)	-0.230059	0.054171	-4.246876	0

Clearly, the constant and Coefficient to DPUSA(-6) are not significant, so can be treated as equal to 0.

Estimating the ADL model:

$$\mathbf{DPEURt = \alpha + \beta_1 DPEUR_{t-6} + \beta_2 DPEUR_{t-12} + \gamma_1 DPUSA_{t-1} + \gamma_2 DPUSA_{t-12} + \varepsilon_t}$$

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000339	0.000268	1.267353	0.2076
DPEUR(-6)	0.168728	0.07108	2.373762	0.0193
DPEUR(-12)	0.655164	0.085627	7.651345	0
DPUSA(-1)	0.232646	0.050778	4.581596	0
DPUSA(-12)	-0.226506	0.054071	-4.189031	0.0001

$$\mathbf{DPEURt} = 0.17^{*}\mathbf{DPEUR_{t-6} + 0.66^{*}DPEUR_{t-12} + 0.23^{*}DPUSA_{t-1} - 0.23^{*}DPUSA_{t-12} + \varepsilon_t}$$

(e) Use the models of parts (c) and (d) to make two series of 12 monthly inflation forecasts for 2011. At each month, you should use the data that are then available, for example, to forecast inflation for September 2011 you can use the data up to and including August 2011. However, do not re-estimate the model and use the coefficients as obtained in parts(c)and (d). For each of the two forecast series, compute the values of the root mean squared error (RMSE), mean absolute error (MAE), and the sum of the forecast errors (SUM). Finally, give your interpretation of the outcomes.

Note: I've also calc same for log differences just in case the instructors meant that, even though inflation is mentioned in the Q.

The complete spreadsheet model is pasted below at the end.

Forecasts & Errors for CPI EUR

Conclusion is that ADL model does a better job at forecasting than AR model as all errors are lower.

t	Actual EUR	Actual USA	AR Model	ADL Model
2011 M 1	131.40	140.40	131.53	131.44
2011 M 2	131.90	141.10	131.68	131.83
2011 M 3	133.70	142.50	132.83	132.93
2011 M 4	134.50	143.40	134.15	134.44
2011 M 5	134.50	144.10	134.58	134.76
2011 M 6	134.50	143.90	134.65	134.81
2011 M 7	133.70	144.00	134.02	133.97
2011 M 8	133.90	144.40	133.92	133.90
2011 M 9	134.90	144.70	134.49	134.54
2011 M 10	135.40	144.40	135.30	135.35
2011 M 11	135.50	144.20	135.46	135.38
2011 M 12	136.00	143.90	135.99	135.95
RMSE			**0.32372**	**0.28684**
MAE			**0.22532**	**0.19608**
SUM			**1.29383**	**0.60725**

Forecasts & Errors for DP EUR

Conclusion is that ADL model does a better job at forecasting than AR model as all errors are lower.

t	Actual EUR	Actual USA	AR Model	ADL Model
2011 M 1	-0.00683	0.00500	-0.00582	-0.00656
2011 M 2	0.00380	0.00497	0.00215	0.00330
2011 M 3	0.01355	0.00987	0.00704	0.00777
2011 M 4	0.00597	0.00630	0.00332	0.00550
2011 M 5	0.00000	0.00487	0.00060	0.00193
2011 M 6	0.00000	-0.00139	0.00114	0.00232
2011 M 7	-0.00597	0.00069	-0.00358	-0.00398
2011 M 8	0.00149	0.00277	0.00163	0.00148
2011 M 9	0.00744	0.00208	0.00439	0.00477
2011 M 10	0.00370	-0.00208	0.00295	0.00332
2011 M 11	0.00074	-0.00139	0.00045	-0.00015
2011 M 12	0.00368	-0.00208	0.00363	0.00333
RMSE			**0.00242345**	**0.00214390**
MAE			**0.00169**	**0.00146**
SUM			**0.00967**	**0.00455**

t	Actual EUR	Actual USA	AR Model	ADL Model	FE_AR	FE_ADL	AE_AR	AE_ADL	FE_AR^2	FE_ADL^2
2010 M 1	128.40000	138.10000								
2010 M 2	128.80000	138.20000								
2010 M 3	130.20000	138.80000								
2010 M 4	130.80000	139.00000								
2010 M 5	130.90000	139.10000								
2010 M 6	130.90000	139.00000								
2010 M 7	130.40000	139.00000								
2010 M 8	130.60000	139.20000								
2010 M 9	131.00000	139.30000								
2010 M 10	131.40000	139.40000								
2010 M 11	131.50000	139.50000								
2010 M 12	132.30000	139.70000								
2011 M 1	131.40000	140.40000	131.53180	131.43517	0.13180	0.03517	0.13180	0.03517	0.01737161	0.00123727
2011 M 2	131.90000	141.10000	131.68271	131.83371	-0.21729	-0.06629	0.21729	0.06629	0.04721313	0.00439376
2011 M 3	133.70000	142.50000	132.83211	132.92948	-0.86789	-0.77052	0.86789	0.77052	0.75323561	0.59370354
2011 M 4	134.50000	143.40000	134.14527	134.43704	-0.35473	-0.06296	0.35473	0.06296	0.12583691	0.00396444
2011 M 5	134.50000	144.10000	134.58080	134.75995	0.08080	0.25995	0.08080	0.25995	0.00652917	0.06757655
2011 M 6	134.50000	143.90000	134.65407	134.81229	0.15407	0.31229	0.15407	0.31229	0.02373607	0.09752399
2011 M 7	133.70000	144.00000	134.01977	133.96546	0.31977	0.26546	0.31977	0.26546	0.10225185	0.07047005
2011 M 8	133.90000	144.40000	133.91855	133.89814	0.01855	-0.00186	0.01855	0.00186	0.00034417	0.00000348
2011 M 9	134.90000	144.70000	134.48872	134.54067	-0.41128	-0.35933	0.41128	0.35933	0.16915042	0.12912057
2011 M 10	135.40000	144.40000	135.29843	135.34920	-0.10157	-0.05080	0.10157	0.05080	0.01031724	0.00258086
2011 M 11	135.50000	144.20000	135.46161	135.38012	-0.03839	-0.11988	0.03839	0.11988	0.00147388	0.01437171
2011 M 12	136.00000	143.90000	135.99233	135.95153	-0.00767	-0.04847	0.00767	0.04847	0.00005876	0.00234969
SUM					**-1.29383**	**-0.60725**	**2.70381**	**2.35301**	**1.25751880**	**0.98729590**
AVG					**-0.10782**	**-0.05060**	**0.22532**	**0.19608**	**0.10479323**	**0.08227466**
SQRT									**0.32371783**	**0.28683560**

t	Actual EUR	Actual USA	AR Model	ADL Model	FE_AR	FE_ADL	AE_AR	AE_ADL	FE_AR^2	FE_ADL^2
2010 M 1	-0.00853	0.00290								
2010 M 2	0.00311	0.00072								
2010 M 3	0.01081	0.00433								
2010 M 4	0.00460	0.00144								
2010 M 5	0.00076	0.00072								
2010 M 6	0.00000	-0.00072								
2010 M 7	-0.00383	0.00000								
2010 M 8	0.00153	0.00144								
2010 M 9	0.00306	0.00072								
2010 M 10	0.00305	0.00072								
2010 M 11	0.00076	0.00072								
2010 M 12	0.00607	0.00143								
2011 M 1	-0.00683	0.00500	-0.00582	-0.00656	0.00100	0.00027	0.00100	0.00027	0.00000101	0.00000007
2011 M 2	0.00380	0.00497	0.00215	0.00330	-0.00165	-0.00050	0.00165	0.00050	0.00000272	0.00000025
2011 M 3	0.01355	0.00987	0.00704	0.00777	-0.00651	-0.00578	0.00651	0.00578	0.00004241	0.00003341
2011 M 4	0.00597	0.00630	0.00332	0.00550	-0.00264	-0.00047	0.00264	0.00047	0.00000697	0.00000022
2011 M 5	0.00000	0.00487	0.00060	0.00193	0.00060	0.00193	0.00060	0.00193	0.00000036	0.00000373
2011 M 6	0.00000	-0.00139	0.00114	0.00232	0.00114	0.00232	0.00114	0.00232	0.00000131	0.00000538
2011 M 7	-0.00597	0.00069	-0.00358	-0.00398	0.00239	0.00198	0.00239	0.00198	0.00000571	0.00000393
2011 M 8	0.00149	0.00277	0.00163	0.00148	0.00014	-0.00001	0.00014	0.00001	0.00000002	0.00000000
2011 M 9	0.00744	0.00208	0.00439	0.00477	-0.00305	-0.00267	0.00305	0.00267	0.00000932	0.00000711
2011 M 10	0.00370	-0.00208	0.00295	0.00332	-0.00075	-0.00038	0.00075	0.00038	0.00000056	0.00000014
2011 M 11	0.00074	-0.00139	0.00045	-0.00015	-0.00028	-0.00089	0.00028	0.00089	0.00000008	0.00000078
2011 M 12	0.00368	-0.00208	0.00363	0.00333	-0.00006	-0.00036	0.00006	0.00036	0.00000000	0.00000013
SUM					**-0.00967**	**-0.00455**	**0.02022**	**0.01755**	**0.00007048**	**0.00005516**
AVG					**-0.00081**	**-0.00038**	**0.00169**	**0.00146**	**0.00000587**	**0.00000460**
SQRT									**0.00242345**	**0.00214390**