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An Econometric Analysis of Inflation and Economic Growth: A Case Study of Canada and UK

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ABSTRACT

This paper is an econometric analysis of the relationship between inflation and economic growth. The inflation affects economic growth negatively, i.e., it reduces economic growth. But there is a question whether inflation is always harmful to economic growth for an economy or not? For analysing the relationship between inflation and economic growth, i have been taken Canada and UK from the G7 countries. The study support the theory developed by Tobin in 1972 that, inflation can lead to a higher growth rate through the difference between nominal and real variables. According to that, higher inflation can allow firms to make adjustments on real wages, that can't do for nominal wages.

INTRODUCTION

In the economic theory, many economists have tried to explain the link between evolution of prices and economic growth. According to Keynes, the stimulus of the economic growth is the effective demand, that is investment and the demand for consumption goods. So, if there is a lower growth, it's because of a lower demand. Hence, the policies to apply are budgetary and monetary ones. The budgetary policy consists of injecting money in the economy to maintain the activity. The mechanism that takes place is called the multiplier. The mean of the monetary one is to increase the supply of money, to allow more credits for the investment and the consumption.

However, for the monetarists, as Friedman for instance, these policies are inefficient, and even dangerous for the economy. Indeed, for them, inflation comes from the enhancement of the money supply.

Fisher identity: $(1+i) = (1+r)\ ((P_{t+1}-P_t\ )/P_t)$

$$(P_{t+1}-P_t/P_t) = (1+i)\ /\ (1+r)$$

We see that the evolution of the prices depends on the nominal and real interest rate. The interest rate depends, in turn, on the supply of money: when the money supply raises, the demand for credits increases, so the demand of money. Thus, the interest rate enhances, which would imply lower investment and consumption. So, inflation slows down economic growth.

That's why the European Central Bank has as a target to keep stable the inflation, which means that the ECB can't play with the money supply.

From a Keynesian point of view, it seems to be a trade-off between unemployment and inflation, as it's been suggested by the Phillips curve: authorities have to choose between struggling against unemployment, which imply expansionary monetary and budgetary policies, or keeping relatively constant the evolution of prices, which underlies unemployment, and threaten economic growth.

So, the aim of this work is to verify the nature of the link between inflation and economic growth.
First, we will explain the econometric model and the assumptions. Then, we will explain the results of the regressions that have been done.

THE ECONOMETRIC MODEL

The work is based on a dataset from the OECD and lists the real GDP per capita as well as the consumer prices index for the countries member of the G7, from 1948 to 1999.

However, we face one problem: some observations are missing on the dependent variable, RGDP, and on the Consumer price index.

To decide whether we can drop some of them, we have to know the reason that explains these missing years. Indeed, if this reason is correlated with ε_{it}, the estimation will be biased.

But here it's not the case: some observations are not missing because the countries don't exist anymore, but because the value was not available after the WW2 as most of the countries members (the European ones) of the G7 had to be rebuilt. So, we can drop the years 1948-1949 and from 1993 to work on a data from 1950 to 1992.

So, the data set lists the following variables:

RGDP is the real GDP per capita and is the dependent variable

CPI is the consumer index prices (base 100 in 1995 for all the countries)

Although there are seven countries, we will choose two of them (Canada and UK) to make a regression on two time series. Indeed, we suppose that the relationship between economic growth and inflation should be the same among similar economies as it's the case within the members of the G7.

To form our model, we will define one new variable from the data:

$\log(RGDP)_t$, which is the logarithm of growth rate of the real GDP per capita

Hence we will work on the following model:

$$\log(RGDP)_t=\beta_0+\beta_1 \log(CPI)_t+\varepsilon_t$$

Where: ε_t is the random term

. β_0 is the intercept

The model is a log-log one because taking the log of the dependent variable permits to obtain a constant weight of the inflation on the economic growth. The logarithmic form of the model is useful as the relation between inflation and growth is not supposed to be linear.

This model will be estimated using the softwares TSP and EVIEWS. As we want to analyse the relationship between the economic growth and the evolution of prices, we will test the following null hypothesis:

H_0: $\beta_1<0$

It means that with the model, we'll test the assumption that there is a negative relationship between inflation and growth. So, inflation reduces growth.

Hence, we will also check the non-monotonicity of this relationship: does inflation is always harmful for the economic growth? Or is it possible to allow a higher inflation in order to be free to lead effective policies to boost the activity?

THE RESULTS OF THE ESTIMATIONS

Canada

From a regression by Ordinary Least Squares method, we have the following results:

The equation: $\log(RGDP) = 7.52027 + 0.507468 \log(CPI) + \varepsilon_t$

		P-value
mean of log(RGDP)	9.26631	
SSR	0.395895	
R-squared	0.918202	
DW test	0.129351	<0.000
JB test	3.28080	0.194

The estimated coefficient of the explanatory variables means that 0.51 % of the change in the inflation rate explains the changes in the economic growth rate.

The table shows that the model seems reliable as the R-squared is close to 1. Nonetheless, the SSR means there's around 40 % of difference between the actual and the estimated dependent variable: the model is under-estimated.

But to be sure, we have to make a diagnostic test to check if the Gauss-Markov hypotheses are fulfilled.
First, we have to check if there is heteroscedasticity. To do so, we take a look at the Breusch-Pagan value:
Then, the Durbin-Watson value indicates if there is serial correlation (or autocorrelation) but we can also make a Breusch-Godfrey LM test:

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	231.5460	Probability	0.000000
Obs*R-squared	36.66590	Probability	0.000000

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 02/01/07 Time: 21:07
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.041722	0.032273	1.292761	0.2035
LOG(CPI)	-0.012982	0.009231	-1.406391	0.1673
RESID(-1)	0.949494	0.062398	15.21664	0.0000

R-squared	0.852695	Mean dependent var	-1.54E-15
Adjusted R-squared	0.845330	S.D. dependent var	0.097088
S.E. of regression	0.038183	Akaike info criterion	-3.625645
Sum squared resid	0.058317	Schwarz criterion	-3.502771
Log likelihood	80.95137	F-statistic	115.7730
Durbin-Watson stat	1.272327	Prob(F-statistic)	0.000000

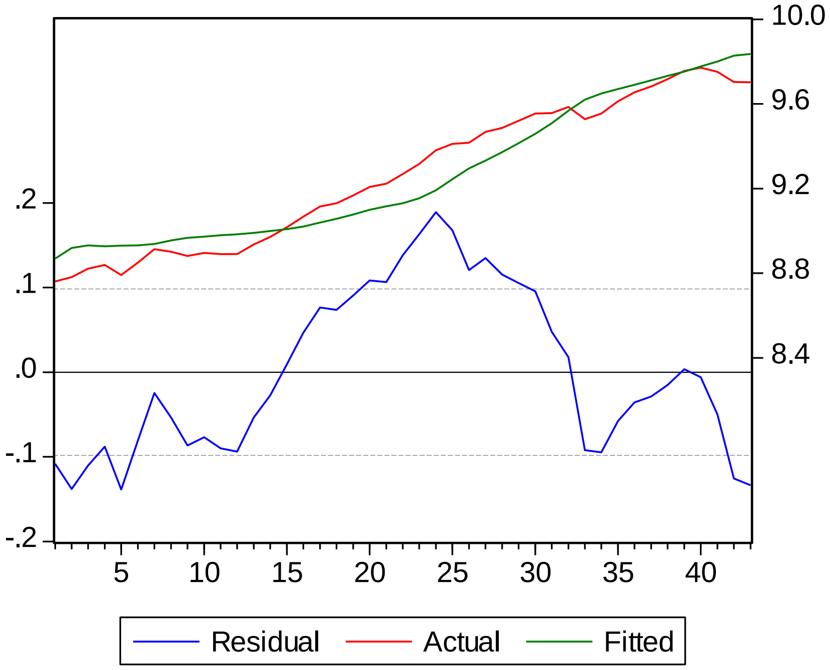
Interpretation of the Breusch-Goldfeld and the DW Test
The Breusch-Goldfeld estimated value shows that there is a correlation between present residuals and previous year residuals.

The DW test shows that, there is an autocorrelation among the residuals so we cannot reject the hypothesis. We also have to verify if the normality of ε_t is respected or not as it's a condition of unbiasedness. Here, we see that the P-value of the JB test is 0.194. We accept the null hypothesis that the residuals don't follow a normal distribution if the P-value is higher than 0.5. So, we can reject the null hypothesis:

$$\hat{e}_t \sim N\,(0;\sigma^2)$$

However, a time series can generate some other problems. Indeed, it can be a seasonality problem, which is not the case here as we have yearly observations and that they concern economic growth.

A second difficulty is the non-stationarity. To check it, we can take a look at the following graph, which shows the evolution of log (RGDP) (its fitted and actual values):



On this graph, we see that both fitted and actual values of log (RGDP) follow a trend, which indicates that this time series is not stationary. We can also test whether it's stationary by operating the Dickey-Fuller test.
So, these are the results of the test:

Null Hypothesis: LOG(RGDP) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.796438	0.8098
Test critical values:	1% level	-3.596616	
	5% level	-2.933158	
	10% level	-2.604867	

*MacKinnon (1996) one-sided p-values.

If we look at the t-statistic of the DF test, we see that its absolute value is lower for each critical value level. This confirms that there is a unit root. To cope with this problem, we make an Augmented Dickey-Fuller test that will compute the first difference of the model to make the time series stationary:

Null Hypothesis: D(LOG(RGDP)) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.019568	0.0002
Test critical values:	1% level	-3.600987	
	5% level	-2.935001	
	10% level	-2.605836	

*MacKinnon (1996) one-sided p-values.

We observe that here, the absolute value of the t-statistic is always higher than the critical values. So, we can reject the null hypothesis that d log (RGDP) has a unit root.
Therefore, our model integrates now the first difference:

$$d\ log(RGDP)_t = \beta_0 + \beta_1\ d\ log(CPI)_t + \varepsilon_t$$

Thus, we do an estimation of the new model:

$$d\ log(RGDP)_t = 0.017699 – 0.792179\ d\ log(CPI)_t + \varepsilon_t$$

Mean of d log(RGDP)	-0.000505
R^2	0.392486
SSR	0.035230
DW test	1.924926

We see that the R^2 of the new model is quite low, but the sum of squared residuals is low too, which means that the estimation is close to the actual value.

In addition, we see that this model exhibits a negative relationship between inflation and economic growth.

Explain the DW Test.
Here, the DW value lies between du and 4-du so the null hypothesis can be rejected and there is no correlation among the residuals.

Then, we have to identify the process that generates the series. To do so, we have to look at the correlogram of the first differentiated model:

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. |** |	. |** |	1	0.205	0.205	1.8914	0.169
.*| . |	.*| . |	2	-0.108	-0.157	2.4325	0.296
. |*. |	. |*. |	3	0.066	0.132	2.6372	0.451
. | . |	.*| . |	4	-0.016	-0.088	2.6503	0.618
.*| . |	.*| . |	5	-0.108	-0.061	3.2314	0.664
.*| . |	.*| . |	6	-0.143	-0.135	4.2834	0.638
. | . |	. |*. |	7	0.063	0.125	4.4926	0.722
. | . |	. | . |	8	0.038	-0.040	4.5705	0.802
. |*. |	. |*. |	9	0.085	0.153	4.9784	0.836
. |*. |	. | . |	10	0.077	-0.024	5.3235	0.869
. | . |	. | . |	11	-0.049	-0.045	5.4681	0.906
. | . |	. | . |	12	-0.024	-0.024	5.5043	0.939
. | . |	. | . |	13	-0.017	0.007	5.5222	0.962
.*| . |	.*| . |	14	-0.082	-0.076	5.9631	0.967
.*| . |	. | . |	15	-0.073	0.001	6.3323	0.974
. | . |	. | . |	16	-0.008	-0.030	6.3364	0.984
.*| . |	.*| . |	17	-0.061	-0.089	6.6078	0.988
**| . |	.*| . |	18	-0.190	-0.185	9.3890	0.950
.*| . |	.*| . |	19	-0.173	-0.147	11.795	0.894
. | . |	. | . |	20	-0.057	-0.056	12.065	0.914

This shows that the partial autocorrelation goes towards zero more fastly than the autocorrelation: on the table we see that the PAC is really close to zero (0.001 at the 15th lag) before the autocorrelation, which means that there is an auto-regressive process.

So now, we can estimate the parameters. We know that there is an auto-regressive process, so the model is:
$(CPI)_t - \gamma_1(CPI)_{t-1} - \gamma_q(CPI)_{t-p} = C(L)CPI_t = \mu + \varepsilon_t$
And we can use the ordinary least squares method:

Mean of d log(RGDP)	9.26631
R²	0.985769
SSR	0.069740
DW test	1.20644
Rho	0.969356

Hence, our final model is:

d log (RGDP)=7.93007+0.371462 d log(CPI)

The model is reliable as the R^2 is very close to unity and that the sum of squared residuals is quite low. In addition, RHO is quite close to 1, which means that this is a good estimation.

Interpretation of DW
The DW value is greater than dL so the null hypothesis there is no positive correlation among residuals so it can be rejected.

To conclude on the case of Canada, we see that the null hypothesis can be rejected, as $\beta_1 > 0$: there is a positive impact of inflation on growth.

United Kingdom:
There is a table to sum up our results for the estimated model:
log (RGDP)=8.23825+0.275717 log (CPI)+ε_t

		P-value
mean of log(RGDP)	9.05736	
SSR	0.286203	
R-squared	0.905345	
DW test	0.130615	<0.000
JB test	1.44240	0.486

For the United Kingdom, there is as well a positive relationship between evolution of prices and economic growth: the evolution of economic growth is explained by 28 % by the inflation rate.

The R^2 is equal to 91 % and there is a difference of almost 29 % between the actual and the fitted value, so the model is reliable.

Then, according to the P-value of the JB test, the residuals follow a normal distribution as the P-value is lower than 0.5.

We have to check for the autocorrelation:

See also the DW (to Interpret)
The DW value is less than dL therefore; the null hypothesis that there is no positive auto-correlation among the residuals it can be rejected.

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	172.6127	Probability	0.000000
Obs*R-squared	34.91017	Probability	0.000000

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 02/03/07 Time: 20:58
Presample missing value lagged residuals set to zero.

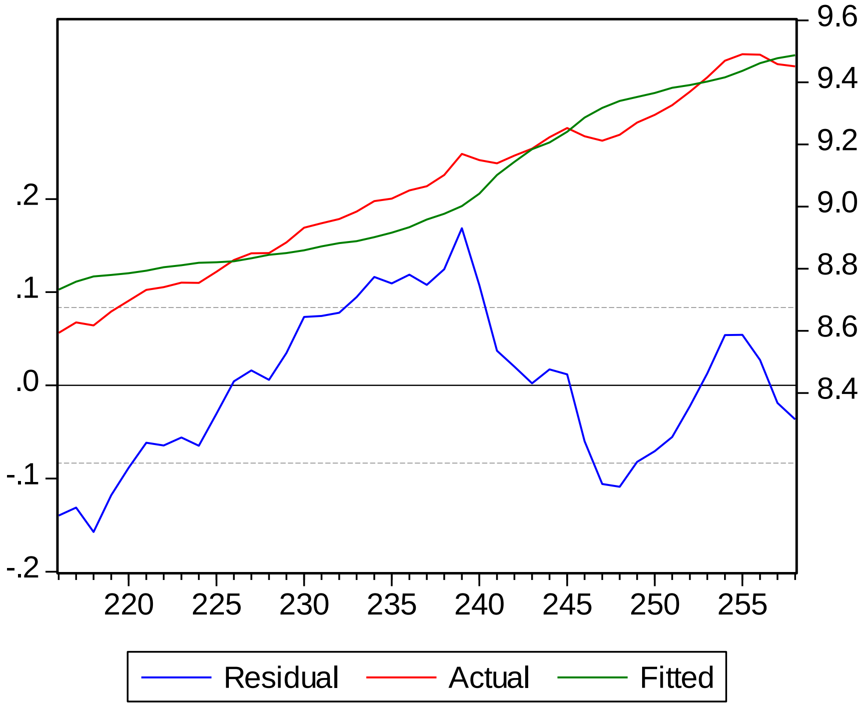
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.008097	0.019016	0.425783	0.6725
LOG(CPI)	-0.002983	0.006118	-0.487612	0.6285
RESID(-1)	0.903807	0.068792	13.13822	0.0000

R-squared	0.811864	Mean dependent var	4.57E-16
Adjusted R-squared	0.802458	S.D. dependent var	0.082549
S.E. of regression	0.036690	Akaike info criterion	-3.705434
Sum squared resid	0.053845	Schwarz criterion	-3.582560
Log likelihood	82.66684	F-statistic	86.30636
Durbin-Watson stat	1.076841	Prob(F-statistic)	0.000000

Interpretation of the Breusch-Goldfeld Test

The probability of the coefficients of the previous residuals is almost zero. So, there is a positive aut-correlation between present residuals and previous residuals.

The following graph shows that the dependent variable exhibits a long-run pattern.



To be sure that there is a non stationary process, we have to perform a Dickey-Fuller test:

Null Hypothesis: LOG(RGDP) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.293523	0.1786
Test critical values:	1% level	-3.592462	
	5% level	-2.931404	
	10% level	-2.603944	

This test confirms the existence of a unit root because the t-statistic has an absolute value that is lower than the critical values.
That's why we have to make again this test on the first difference of the model:

Null Hypothesis: D(LOG(RGDP)) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.552728	0.0000
Test critical values:	1% level	-3.592462	
	5% level	-2.931404	
	10% level	-2.603944	

*MacKinnon (1996) one-sided p-values.

We see that now the absolute value of the t-statistic is clearly greater than the critical values.
Therefore, we have to do an estimation of the new model:

$$d \log (RGDP)= -0.004071-1.022994 \; d \log(CPI)+\varepsilon_t$$

Mean of d log(RGDP)	-0.000433
R²	0.511546
SSR	1.097021
DW test	1.012220

The R^2 is just around 50 % and the sum of squared residuals is very high, which means that the model is not really reliable.

Interpret the DW

The DW value is less than dL therefore the null hypothesis that there is no positive auto-correlation among the residuals so it can be rejected.

The second step of the analysis is to know which process generates the series: is it an auto-regressive or a moving average one?

Date: 02/06/07 Time: 13:49
Sample: 216 258
Included observations: 43

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
.|. |	.|. |	1	-0.009	-0.009	0.0035	0.953
.|. |	.|. |	2	0.025	0.025	0.0342	0.983
.|. |	.|. |	3	-0.027	-0.026	0.0691	0.995
.|. |	.|. |	4	-0.016	-0.017	0.0812	0.999
.|. |	.|. |	5	-0.016	-0.015	0.0940	1.000
.|. |	.|. |	6	0.009	0.009	0.0984	1.000
.|. |	.|. |	7	-0.004	-0.003	0.0991	1.000
.|. |	.|. |	8	0.011	0.010	0.1062	1.000
.|. |	.|. |	9	-0.018	-0.018	0.1245	1.000
.|. |	.|. |	10	-0.018	-0.019	0.1441	1.000
.|. |	.|. |	11	-0.007	-0.006	0.1472	1.000
.|. |	.|. |	12	0.011	0.011	0.1543	1.000
.|. |	.|. |	13	-0.019	-0.020	0.1781	1.000
.|. |	.|. |	14	-0.033	-0.036	0.2513	1.000
.|. |	.|. |	15	-0.001	-0.000	0.2513	1.000
.|. |	.|. |	16	-0.002	-0.001	0.2516	1.000
.|. |	.|. |	17	-0.011	-0.013	0.2609	1.000
.|. |	.|. |	18	-0.022	-0.025	0.2994	1.000
.|. |	.|. |	19	0.003	0.002	0.3004	1.000
.|. |	.|. |	20	-0.017	-0.017	0.3253	1.000

We see here that autocorrelation moves slowly towards zero but is never equal to zero: we face an auto-regressive process. As in the case of Canada, we can use the OLSQ method. And we obtain the final model:

d log(RGDP)=8.49604+0.170977 d log(CPI)

Mean of d log(RGDP)	9.05736
R^2	0.975069
SSR	0.076404
DW	1.15918
RHO	0.987446

We notice that the model is reliable because the R^2 is almost equal to 1 and that the SSR is low. Moreover, rho is very close to unity, which is another indicator of goodness-of-fit.

Interpret DW

The DW value is less than dL therefore the null hypothesis that there is no positive auto-correlation among the residuals so it can be rejected.

Conclude on: H_0: β_1<0

CONCLUSION

The two examples on which we have worked exhibit a positive link between these two variables. This result is not the expected one: according to many economists, inflation must be struggled. This theory is seen reliable by the governments, as we can see it at the European level for instance.

Hence, this result, emphasized by many others, put this statement into question, as well as the policies that aim to a stabilization of the inflation are wrong: according to the empirical works, trying to slow down the evolution of prices means reducing the economic growth rate.

This can support the theory developed by Tobin in 1972: inflation can lead to a higher growth rate through the difference between nominal and real variables. According to him, higher inflation can allow firms to make adjustments on real wages, adjustments that they can't do for nominal wages: with an increasing inflation, real wages are reducing. Furthermore, the real interest rates decrease, which means that the investment can be enhanced. So, the growth increases. In addition, for him, zero inflation doesn't mean that uncertainty will be reduced. **(See Romer book p550)**

Still, there are some limits to our work. It is based only on one independent variable (consumer prices index), which can bias the result.

However, some others studies has been made, allowing for some other variables such as public expenditure, direct foreign investment, gross investment or fertility rate for example, which gives a more complete idea of all the factors that can influence growth.

[_we don't allow for the aim of this inflation: is it the result of policies which tend to lead to a social improvement? So, that is why it's difficult to draw any sharp conclusion.

_forecasting about the policy of the European Central Bank: so even if as we showed, there's a negative relationship between inflation and growth, there should also be a positive one. That is that searching to maintain constant the general increase of prices can lead to a decrease of economic growth, so to an enhancement of unemployment.]

Appendix

I. PART ON CANADA:

The OLSQ estimation for Canada

Dependent Variable: LOG(RGDP)
Method: Least Squares
Date: 02/01/07 Time: 20:44
Sample: 1 43
Included observations: 43

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.520274	0.082756	90.87243	0.0000
LOG(CPI)	0.507468	0.023655	21.45314	0.0000

R-squared	0.918202	Mean dependent var	9.266310
Adjusted R-squared	0.916207	S.D. dependent var	0.339465
S.E. of regression	0.098265	Akaike info criterion	-1.756905
Sum squared resid	0.395896	Schwarz criterion	-1.674988
Log likelihood	39.77345	F-statistic	460.2374
Durbin-Watson stat	0.129351	Prob(F-statistic)	0.000000

The Dickey-Fuller test

Null Hypothesis: LOG(RGDP) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.796438	0.8098
Test critical values:	1% level	-3.596616	

	5% level	-2.933158
	10% level	-2.604867

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LOG(RGDP))
Method: Least Squares
Date: 02/01/07 Time: 20:53
Sample (adjusted): 2 43
Included observations: 42 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(RGDP(-1))	-0.011121	0.013963	-0.796438	0.4305
C	0.125359	0.129328	0.969311	0.3382

R-squared	0.015610	Mean dependent var	0.022424
Adjusted R-squared	-0.008999	S.D. dependent var	0.029960
S.E. of regression	0.030094	Akaike info criterion	-4.122524
Sum squared resid	0.036226	Schwarz criterion	-4.039778
Log likelihood	88.57300	F-statistic	0.634314
Durbin-Watson stat	1.583329	Prob(F-statistic)	0.430479

The OLSQ estimation for the new model

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LOG(RGDP),2)
Method: Least Squares
Date: 02/01/07 Time: 20:55
Sample (adjusted): 3 43
Included observations: 41 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LOG(RGDP(-1)))	-0.792179	0.157818	-5.019568	0.0000
C	0.017699	0.005932	2.983858	0.0049

R-squared	0.392486	Mean dependent var	-0.000505
Adjusted R-squared	0.376909	S.D. dependent var	0.038076
S.E. of regression	0.030055	Akaike info criterion	-4.123996
Sum squared resid	0.035230	Schwarz criterion	-4.040407
Log likelihood	86.54191	F-statistic	25.19607
Durbin-Watson stat	1.924926	Prob(F-statistic)	0.000012

The estimation of the parameters with AR1 command (TSP)

FIRST-ORDER SERIAL CORRELATION OF THE ERROR

Objective function: Exact ML (keep first obs.)
Working space used: 947

STARTING VALUES

	C	LCPI	RHO
VALUE	7.52027	0.50747	0.00000

F= -39.773	FNEW= -73.025	ISQZ= 1	STEP= 0.50000	CRIT= 51.842
F= -73.025	FNEW= -82.677	ISQZ= 2	STEP= 0.25000	CRIT= 67.951
F= -82.677	FNEW= -83.922	ISQZ= 1	STEP= 0.50000	CRIT= 4.6590
F= -83.922	FNEW= -84.274	ISQZ= 0	STEP= 1.0000	CRIT= 0.60417
F= -84.274	FNEW= -84.308	ISQZ= 0	STEP= 1.0000	CRIT= 0.66564E-01
F= -84.308	FNEW= -84.309	ISQZ= 0	STEP= 1.0000	CRIT= 0.23462E-02
F= -84.309	FNEW= -84.309	ISQZ= 0	STEP= 1.0000	CRIT= 0.31674E-05
F= -84.309	FNEW= -84.309	ISQZ= 0	STEP= 1.0000	CRIT= 0.84382E-11

CONVERGENCE ACHIEVED AFTER 8 ITERATIONS

20 FUNCTION EVALUATIONS.

Dependent variable: LRGDP
Current sample: 1 to 43
Number of observations: 43

Mean of dep. var. = 9.26631	Adjusted R-squared = .985058
Std. dev. of dep. var. = .339465	Durbin-Watson = 1.20644
Sum of squared residuals = .069740	Rho (autocorrelation coef.) = .969356
Variance of residuals = .174351E-02	Schwarz B.I.C. = -78.6676
Std. error of regression = .041755	Log likelihood = 84.3094
R-squared = .985769	

Parameter	Estimate	Standard Error	t-statistic	P-value
C	7.93007	.349316	22.7017	[.000]
LCPI	.371462	.099601	3.72949	[.000]
RHO	.969356	.038271	25.3285	[.000]

Standard Errors computed from analytic second derivatives (Newton)

II. PART ON UNITED KINGDOM:

OLSQ estimation

Dependent Variable: LOG(RGDP)
Method: Least Squares
Date: 02/03/07 Time: 20:52
Sample: 216 258
Included observations: 43

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	8.238253	0.043281	190.3427	0.0000
LOG(CPI)	0.275717	0.013923	19.80282	0.0000

R-squared	0.905345	Mean dependent var	9.057362
Adjusted R-squared	0.903036	S.D. dependent var	0.268312
S.E. of regression	0.083550	Akaike info criterion	-2.081353
Sum squared resid	0.286203	Schwarz criterion	-1.999437
Log likelihood	46.74909	F-statistic	392.1519
Durbin-Watson stat	0.130615	Prob(F-statistic)	0.000000

Dickey-Fuller test

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LOG(RGDP))
Method: Least Squares
Date: 02/03/07 Time: 20:56
Sample: 216 258
Included observations: 43

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(RGDP(-1))	-0.197877	0.086276	-2.293523	0.0270
C	1.789044	0.782134	2.287388	0.0274

R-squared	0.113710	Mean dependent var	-0.003989
Adjusted R-squared	0.092093	S.D. dependent var	0.161658
S.E. of regression	0.154035	Akaike info criterion	-0.857883
Sum squared resid	0.972794	Schwarz criterion	-0.775967
Log likelihood	20.44449	F-statistic	5.260247
Durbin-Watson stat	0.787263	Prob(F-statistic)	0.027016

Estimation of the new model

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LOG(RGDP),2)
Method: Least Squares
Date: 02/03/07 Time: 20:57
Sample: 216 258
Included observations: 43

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LOG(RGDP(-1)))	-1.022994	0.156117	-6.552728	0.0000
C	-0.004071	0.024951	-0.163159	0.8712

R-squared	0.511546	Mean dependent var	-0.000433
Adjusted R-squared	0.499632	S.D. dependent var	0.231244
S.E. of regression	0.163574	Akaike info criterion	-0.737701
Sum squared resid	1.097021	Schwarz criterion	-0.655785
Log likelihood	17.86058	F-statistic	42.93825
Durbin-Watson stat	1.012220	Prob(F-statistic)	0.000000

The estimation of the parameters with the AR1 command (TSP)

FIRST-ORDER SERIAL CORRELATION OF THE ERROR

Objective function: Exact ML (keep first obs.)
Working space used: 947
STARTING VALUES

	C	LCPI	RHO
VALUE	8.23825	0.27572	0.00000

F= -46.749 FNEW= -80.026 ISQZ= 1 STEP= 0.50000 CRIT= 52.066
F= -80.026 FNEW= -89.539 ISQZ= 2 STEP= 0.25000 CRIT= 59.884
F= -89.539 FNEW= -90.492 ISQZ= 0 STEP= 1.0000 CRIT= 1.8161
F= -90.492 FNEW= -90.741 ISQZ= 2 STEP= 0.25000 CRIT= 2.7671
F= -90.741 FNEW= -90.952 ISQZ= 0 STEP= 1.0000 CRIT= 0.40125
F= -90.952 FNEW= -90.973 ISQZ= 0 STEP= 1.0000 CRIT= 0.36807E-01
F= -90.973 FNEW= -90.975 ISQZ= 0 STEP= 1.0000 CRIT= 0.35101E-02
F= -90.975 FNEW= -90.975 ISQZ= 0 STEP= 1.0000 CRIT= 0.37918E-04
F= -90.975 FNEW= -90.975 ISQZ= 0 STEP= 1.0000 CRIT= 0.46795E-08
F= -90.975 FNEW= -90.975 ISQZ= 0 STEP= 1.0000 CRIT= 0.71647E-16

CONVERGENCE ACHIEVED AFTER 10 ITERATIONS

25 FUNCTION EVALUATIONS.

Dependent variable: LRGDP
Current sample: 216 to 258
Number of observations: 43

Mean of dep. var. = 9.05736 Adjusted R-squared = .973823
Std. dev. of dep. var. = .268312 Durbin-Watson = 1.15918
Sum of squared residuals = .076404 Rho (autocorrelation coef.) = .987446
Variance of residuals = .191010E-02 Schwarz B.I.C. = -85.3327
Std. error of regression = .043705 Log likelihood = 90.9745
R-squared = .975069

Parameter	Estimate	Standard Error	t-statistic	P-value
C	8.49604	.243088	34.9505	[.000]
LCPI	.170977	.062843	2.72068	[.007]
RHO	.987446	.020057	49.2313	[.000]

Standard Errors computed from analytic second derivatives
(Newton)

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