


```
.
. drop if Year < 1955
(32 observations deleted)
```

```
. drop if Year > 2009
(0 observations deleted)
```

```
.
. sum d_Y
```

Variable	Obs	Mean	Std. Dev.	Min	Max
d_Y	220	.0077219	.0092819	-.0274444	.0385857

```
. sum Y_d_Y
```

Variable	Obs	Mean	Std. Dev.	Min	Max
Y_d_Y	220	3.088771	3.712768	-10.97775	15.43427

The mean growth rate is 3.09%

The standard deviation of ΔY_t is 3.71%

```
. corrgram Y_d_Y, lags(4)
```

Unit free

LAG	AC	PAC	Q	Prob>Q	-1	0	1	-1	0	1
						[Autocorrelation]			[Partial Autocor]	
1	0.3324	0.3327	24.64	0.0000		--			--	
2	0.2076	0.1101	34.296	0.0000		-				
3	0.0516	-0.0530	34.894	0.0000						
4	0.0017	-0.0295	34.895	0.0000						

```
.
. arima Y_d_Y, ar(1)
```

The coefficient is 0.339, which is statistically significantly different from zero. The 95% significance interval is (0.229,0.448)

(setting optimization to BHHH)

Iteration 0: log likelihood = -587.12944

Iteration 1: log likelihood = -587.10593

Iteration 2: log likelihood = -587.10403

Iteration 3: log likelihood = -587.1039

Iteration 4: log likelihood = -587.10389

ARIMA regression

Sample: 33 - 252

Number of obs = 220

Wald chi2(1) = 36.83

Log likelihood = -587.1039

Prob > chi2 = 0.0000

-----+-----							
		OPG					
Y_d_Y		Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
-----+-----							
Y_d_Y							
_cons		3.111904	.3578132	8.70	0.000	2.410603	3.813205
-----+-----							
ARMA							
ar							
L1.		.3389078	.0558427	6.07	0.000	.2294582	.4483574
-----+-----							
/sigma		3.48824	.131526	26.52	0.000	3.230454	3.746026

Note: The test of the variance against zero is one sided, and the two-sided confidence interval is truncated at zero.

. estat ic

Akaike's information criterion and Bayesian information criterion

Model		Obs	ll(null)	ll(model)	df	AIC	BIC
-----+-----							
.		220	.	-587.1039	3	1180.208	1190.389

Note: N=Obs used in calculating BIC; see [R] BIC note.

. arima Y_d_Y , ar(2)

The coefficient is 0.112, which is statistically significantly different from zero at a 5% confidence level, but not significant at a %1 level. Yes, this model is preferred to the AR(1) model

(setting optimization to BHHH)

Iteration 0: log likelihood = -595.33066

Iteration 1: log likelihood = -595.31296

Iteration 2: log likelihood = -595.31061

Iteration 3: log likelihood = -595.31026

Iteration 4: log likelihood = -595.31022

(switching optimization to BFGS)

Iteration 5: log likelihood = -595.31022

ARIMA regression

Sample: 33 - 252

Number of obs = 220

Wald chi2(1) = 14.03

Log likelihood = -595.3102

Prob > chi2 = 0.0002

-----+-----							
		OPG					
Y_d_Y	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]		
-----+-----							
Y_d_Y							
_cons		3.103701	.3205067	9.68	0.000	2.47552	3.731883
-----+-----							
ARMA							
ar							
L2		.2118108	.0565555	3.75	0.000	.100964	.3226577
-----+-----							
/sigma		3.621119	.1319396	27.45	0.000	3.362522	3.879716

Note: The test of the variance against zero is one sided, and the two-sided confidence interval is truncated at zero.

. estat ic

Akaike's information criterion and Bayesian information criterion

	Model	Obs	ll(null)	ll(model)	df	AIC	BIC
-----+-----							
	.	220	.	-595.3102	3	1196.62	1206.801

Note: N=Obs used in calculating BIC; see [R] BIC note.

. arima Y_d_Y , ar(3)

(setting optimization to BHHH)

Iteration 0: log likelihood = -599.96976

Iteration 1: log likelihood = -599.95846

Iteration 2: log likelihood = -599.9574

Iteration 3: log likelihood = -599.95727

Iteration 4: log likelihood = -599.95726

ARIMA regression

Sample: 33 - 252	Number of obs	=	220
	Wald chi2(1)	=	0.77
Log likelihood = -599.9573	Prob > chi2	=	0.3811

		OPG					
	Y_d_Y	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
-----+-----							
Y_d_Y							
	_cons	3.091361	.2687297	11.50	0.000	2.56466	3.618061
-----+-----							
ARMA							
	ar						
	L3.	.0526163	.0600759	0.88	0.381	-.0651303	.1703629
-----+-----							
	/sigma	3.698926	.1455392	25.42	0.000	3.413674	3.984178
-----+-----							

Note: The test of the variance against zero is one sided, and the two-sided confidence interval is truncated at zero.

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Akaike's information criterion and Bayesian information criterion

Model	Obs	ll(null)	ll(model)	df	AIC	BIC
-----+-----						
.	220	.	-599.9573	3	1205.915	1216.095
-----+-----						

Note: N=Obs used in calculating BIC; see [R] BIC note.

. arima Y_d_Y , ar(4)

(setting optimization to BHHH)

Iteration 0: log likelihood = -600.26231
Iteration 1: log likelihood = -600.25662
Iteration 2: log likelihood = -600.25616
Iteration 3: log likelihood = -600.25611

ARIMA regression

Sample: 33 - 252	Number of obs	=	220
	Wald chi2(1)	=	0.00

Log likelihood = -600.2561 Prob > chi2 = 0.9772

		OPG					
Y_d_Y		Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
-----+-----							
Y_d_Y							
_cons		3.089513	.2554137	12.10	0.000	2.588911	3.590115
-----+-----							
ARMA							
ar							
L4.		.0017235	.0603721	0.03	0.977	-.1166036	.1200506
-----+-----							
/sigma		3.704077	.1424072	26.01	0.000	3.424964	3.98319

Note: The test of the variance against zero is one sided, and the two-sided confidence interval is truncated at zero.

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Akaike's information criterion and Bayesian information criterion

Model		Obs	ll(null)	ll(model)	df	AIC	BIC
-----+-----							
.		220	.	-600.2561	3	1206.512	1216.693

Note: N=Obs used in calculating BIC; see [R] BIC note.

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. varsoc Y_d_Y

AIC : 2 BIC : 1

Selection-order criteria

Sample: 37 - 252

Number of obs = 216

-----+-----									
lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC	
-----+-----									
0	-588.168				13.6999	5.45526	5.46158	5.47089	
1	-575.691	24.954*	1	0.000	12.3187	5.34899	5.36162*	5.38025*	
2	-574.347	2.6877	1	0.101	12.2795*	5.34581*	5.36475	5.39269	
3	-574.089	.5178	1	0.472	12.3641	5.35267	5.37792	5.41518	
4	-573.995	.18792	1	0.665	12.4683	5.36106	5.39263	5.43919	
-----+-----									

Endogenous: Y_d_Y

Exogenous: _cons

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. dfuller Y_d_Y , trend

Dickey-Fuller test for unit root

Number of obs = 219

----- Interpolated Dickey-Fuller -----				
	Test	1% Critical	5% Critical	10% Critical
	Statistic	Value	Value	Value

Z(t)	-10.643	-4.000	-3.434	-3.134

MacKinnon approximate p-value for Z(t) = 0.0000

The t-statistic is -10.643, which is smaller than 1% critical value. Therefore the null hypothesis that Y_t has a unit root is rejected, namely, Y_t is stationary around a deterministic trend.

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