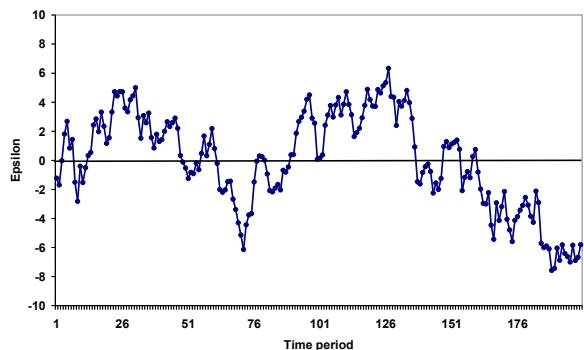


Time series data: Part 2

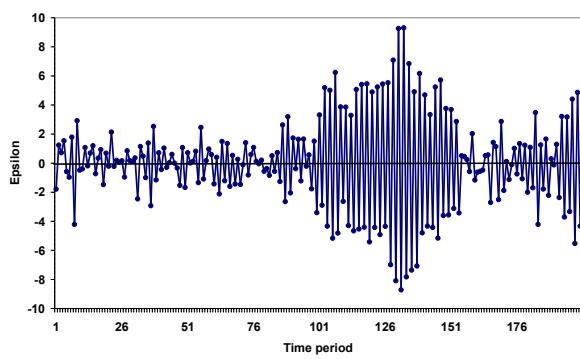
1

Plot of Epsilon over Time -- Case 1



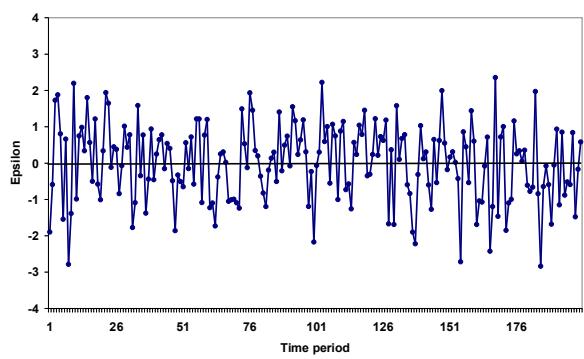
2

Plot of Epsilon over Time -- Case 2

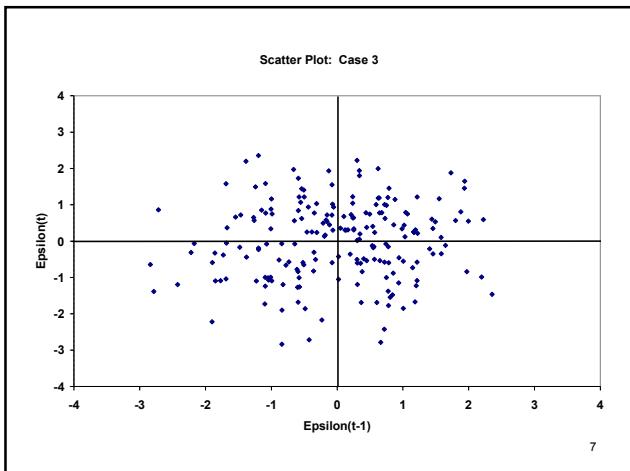
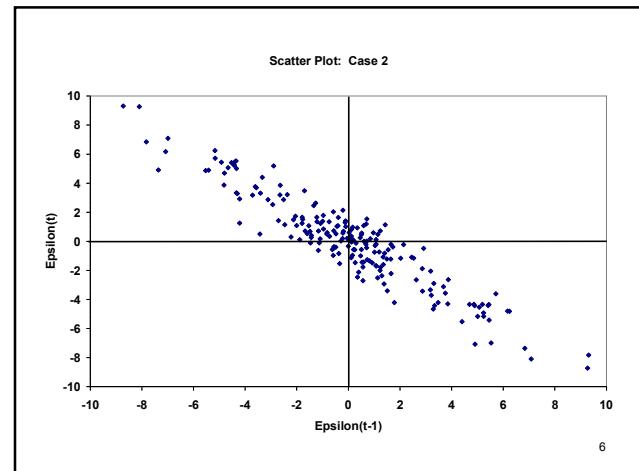
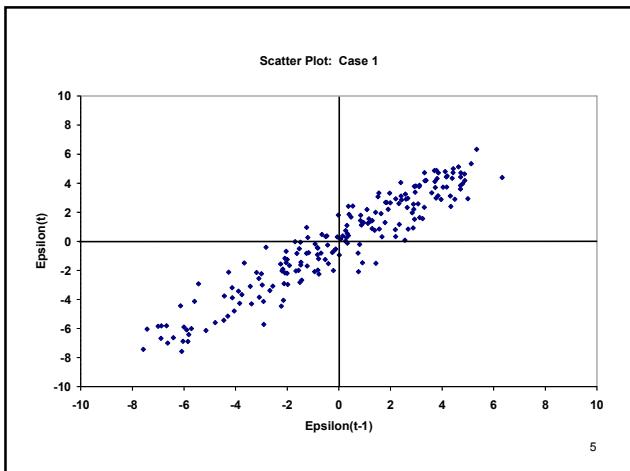


3

Plot of Epsilon over Time -- Case 3



4

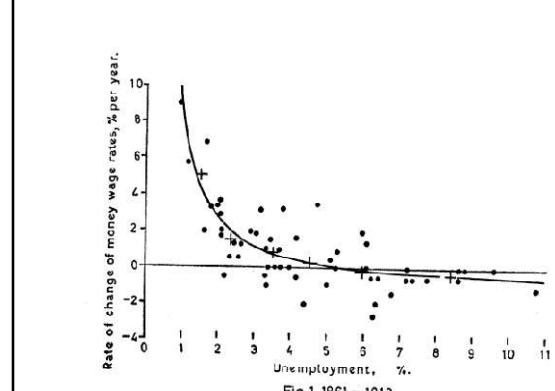


DW Statistic

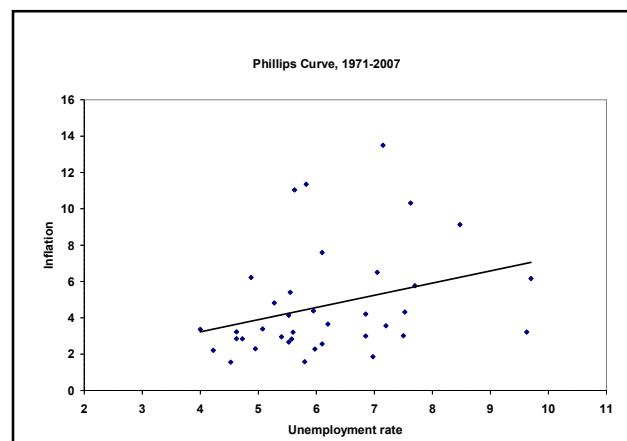
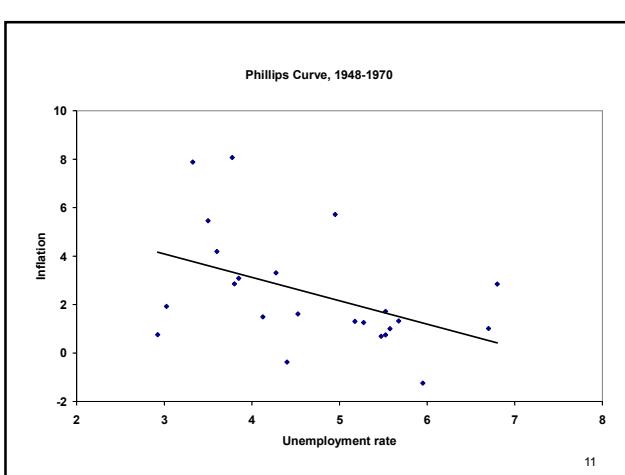
- For $0 < \rho < 1$
- $H_0: \rho = 0$
- $H_a: \rho > 0$
 - $\hat{d} < d_l$ reject null
 - $d_l \leq \hat{d} < d_u$ uncertain
 - $\hat{d} \geq d_u$ cannot reject null

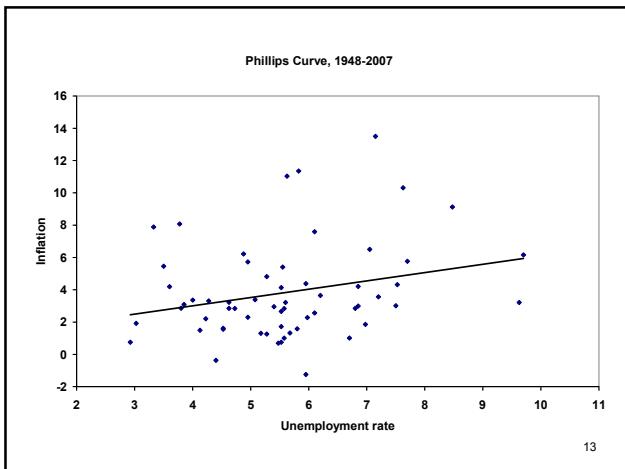
8

n	K=1				K=2				K=3				K=4				K=5				K=6				K=7				K=8				K=9				K=10										
	dL	dU	dL	dU	dL	dU	dL	dU	dL	dU	dL	dU	dL	dU	dL	dU	dL	dU																													
20	1.352	1.480	1.284	1.567	1.214	1.450	1.143	1.739	1.071	1.833	0.966	1.831	0.956	2.024	0.854	2.241	0.782	2.251	0.712	2.345																											
31	1.365	1.495	1.297	1.570	1.229	1.459	1.160	1.732	1.090	1.825	1.030	1.822	0.930	2.018	0.879	2.240	0.818	2.246	0.741	2.335																											
32	1.372	1.502	1.309	1.574	1.244	1.459	1.167	1.732	1.108	1.819	1.041	1.809	0.972	2.004	0.904	2.202	0.834	2.201	0.769	2.346																											
33	1.383	1.508	1.321	1.577	1.248	1.461	1.181	1.730	1.127	1.813	1.061	1.800	0.994	1.991	0.927	2.085	0.861	2.181	0.798	2.231																											
34	1.393	1.514	1.333	1.569	1.271	1.452	1.208	1.728	1.144	1.808	1.079	1.891	1.015	1.973	0.959	2.069	0.885	2.162	0.821	2.237																											
35	1.402	1.519	1.343	1.584	1.283	1.453	1.222	1.728	1.160	1.803	1.087	1.884	1.024	1.967	0.971	2.054	0.898	2.144	0.845	2.224																											
36	1.411	1.520	1.350	1.587	1.285	1.454	1.228	1.729	1.175	1.799	1.114	1.878	1.053	1.957	0.981	2.041	0.909	2.127	0.869	2.235																											
37	1.419	1.530	1.360	1.599	1.307	1.455	1.249	1.723	1.180	1.811	1.131	1.870	1.071	1.949	1.011	2.029	0.951	2.111	0.889	2.197																											
38	1.437	1.535	1.373	1.604	1.318	1.456	1.261	1.722	1.200	1.792	1.146	1.864	1.083	1.939	1.031	2.017	0.970	2.098	0.912	2.180																											
39	1.455	1.540	1.383	1.597	1.328	1.458	1.272	1.722	1.211	1.792	1.161	1.859	1.103	1.932	1.047	2.007	0.969	2.081	0.932	2.164																											
40	1.442	1.544	1.391	1.603	1.338	1.459	1.285	1.721	1.230	1.788	1.175	1.854	1.120	1.923	1.064	1.997	1.008	2.073	0.952	2.149																											
41	1.475	1.589	1.439	1.615	1.383	1.466	1.336	1.720	1.287	1.776	1.238	1.835	1.189	1.895	1.139	1.958	1.089	2.022	1.059	2.083																											
50	1.503	1.585	1.469	1.638	1.421	1.471	1.378	1.721	1.335	1.776	1.291	1.822	1.216	1.875	1.201	1.930	1.156	1.984	1.116	2.011																											
55	1.518	1.603	1.489	1.641	1.452	1.481	1.414	1.724	1.374	1.786	1.334	1.814	1.284	1.861	1.253	1.909	1.212	1.959	1.176	2.010																											
60	1.540	1.616	1.513	1.652	1.489	1.489	1.444	1.727	1.408	1.767	1.372	1.808	1.335	1.850	1.268	1.894	1.246	1.939	1.223	1.984																											
65	1.567	1.659	1.539	1.669	1.503	1.484	1.471	1.731	1.485	1.767	1.404	1.805	1.370	1.841	1.356	1.883	1.301	1.964	1.264	2.047																											
70	1.583	1.641	1.559	1.672	1.525	1.703	1.404	1.735	1.484	1.768	1.433	1.802	1.401	1.833	1.369	1.874	1.337	1.910	1.309	1.948																											
75	1.598	1.652	1.571	1.689	1.548	1.709	1.515	1.739	1.487	1.770	1.418	1.801	1.453	1.831	1.425	1.861	1.397	1.893	1.369	1.935																											
80	1.611	1.662	1.596	1.688	1.569	1.715	1.534	1.743	1.507	1.772	1.460	1.801	1.453	1.831	1.425	1.861	1.397	1.893	1.369	1.935																											



10





```
* The order of the time series
* data must be specified by an
* index. Here, we use year as the
* index
tset year
time variable: year, 1947 to 2007
delta: 1 unit
```

14

```
* run classical phillips curve
reg inflation unemp

Source |      SS          df         MS
Model |  33.5634573   1  33.5634573
Residual | 479.480783   58  8.26691005
Total |  513.04424   59  8.69566509

inflation |   Coef.    Std. Err.      t    P>|t| [95% Conf. Interval]
unemp | .5138821  .2550362  2.01  0.049  .0033718  1.024392
cons | .9519491  1.474108  0.65  0.521  -1.998798  3.902696

* get durbin watson statistic
estat dwatson

durbin-Watson d-statistic( 2, 60) = .8076584
```

15

	k=1		k=2		k=3		k=4		k=5		k=6		k=7		k=8		k=9		k=10	
	dL	dU																		
30	1.852	1.489	1.884	1.567	1.214	1.659	1.143	1.759	1.071	1.833	0.998	1.931	0.924	1.034	0.854	2.141	0.782	2.251	0.713	2.343
31	1.863	1.496	1.897	1.570	1.229	1.659	1.166	1.735	1.090	1.825	1.020	1.920	0.959	2.018	0.879	2.120	0.810	2.226	0.741	2.333
32	1.878	1.502	1.899	1.574	1.244	1.659	1.177	1.752	1.09	1.819	1.041	1.909	0.972	2.004	0.904	2.102	0.836	2.205	0.769	2.306
33	1.883	1.509	1.921	1.577	1.258	1.651	1.193	1.750	1.127	1.813	1.061	1.903	0.996	1.98	0.927	2.085	0.861	2.181	0.796	2.301
34	1.893	1.514	1.933	1.580	1.271	1.652	1.206	1.758	1.144	1.808	1.079	1.902	1.015	1.97	0.950	2.089	0.885	2.167	0.821	2.307
35	1.402	1.521	1.943	1.587	1.285	1.653	1.223	1.750	1.160	1.803	1.097	1.884	1.026	1.967	0.971	2.080	0.889	2.144	0.845	2.316
36	1.411	1.525	1.948	1.591	1.287	1.654	1.226	1.751	1.164	1.805	1.102	1.885	1.025	1.968	0.975	2.091	0.893	2.147	0.855	2.315
37	1.419	1.530	1.948	1.596	1.297	1.655	1.240	1.753	1.190	1.795	1.131	1.870	1.071	1.948	1.011	2.099	0.891	2.113	0.891	2.317
38	1.427	1.535	1.973	1.594	1.318	1.664	1.261	1.723	1.204	1.792	1.146	1.864	1.068	1.939	1.020	2.017	0.970	2.099	0.912	2.318
39	1.435	1.540	1.982	1.597	1.328	1.665	1.273	1.722	1.218	1.789	1.161	1.882	1.047	2.007	0.990	2.087	0.992	2.154		
40	1.442	1.544	1.991	1.600	1.338	1.669	1.285	1.721	1.230	1.784	1.175	1.854	1.120	1.934	1.064	1.997	1.008	2.072	0.963	2.149
45	1.475	1.566	1.990	1.615	1.383	1.666	1.336	1.720	1.297	1.776	1.238	1.835	1.169	1.959	1.139	1.959	1.088	2.023	1.038	2.008
50	1.503	1.585	1.982	1.628	1.421	1.674	1.378	1.721	1.335	1.771	1.301	1.832	1.244	1.875	1.201	1.930	1.156	1.995	1.110	2.044
54	1.578	1.607	1.990	1.641	1.457	1.681	1.414	1.724	1.374	1.768	1.334	1.816	1.264	1.874	1.213	1.959	1.170	2.016		
60	1.549	1.616	1.914	1.652	1.480	1.689	1.444	1.727	1.408	1.767	1.372	1.808	1.335	1.835	1.298	1.894	1.269	1.939	1.222	1.994
65	1.587	1.629	1.938	1.682	1.509	1.699	1.471	1.731	1.438	1.787	1.404	1.805	1.370	1.848	1.339	1.882	1.301	1.923	1.286	1.959
70	1.583	1.641	1.954	1.672	1.525	1.703	1.494	1.735	1.454	1.768	1.453	1.802	1.401	1.838	1.369	1.874	1.337	1.910	1.305	1.948
75	1.598	1.652	1.971	1.680	1.541	1.709	1.515	1.739	1.487	1.770	1.458	1.803	1.428	1.834	1.399	1.887	1.369	1.901	1.339	1.935
80	1.611	1.660	1.985	1.683	1.560	1.715	1.534	1.743	1.507	1.772	1.480	1.803	1.453	1.831	1.425	1.861	1.397	1.893	1.369	1.925

16

```

. * output residual
. predict resid_a, residual
(1 missing value generated)

.

. * lag the variable 1 period
. gen resid_a1=resid_a[_n-1]
(2 missing values generated)

.

. * estimate ar(1) term
. reg resid_a resid_a1, noconst

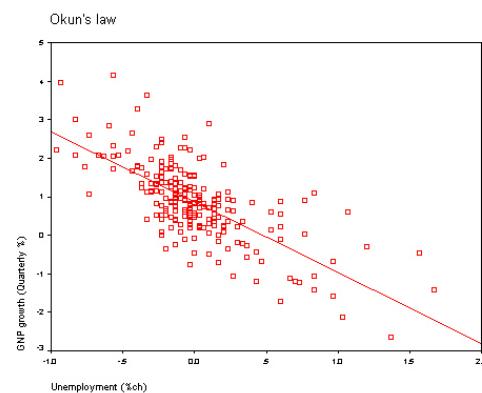
      Source |       SS           df          MS
Model | 154.739524        1  154.739524
Residual | 297.909892       58  5.13637744
Total | 452.649415       59  7.67202399

Number of obs = 59
F( 1, 58) = 30.13
Prob > F = 0.0000
R-squared = 0.3419
Adj R-squared = 0.3303
Root MSE = 2.2664

      resid_a |   Coef.  Std. Err.      t    P>|t| [95% Conf. Interval]
resid_a1 | .568224 .1035255 5.49 0.000 .3609952 .7754529

```

17



18

```

. *now estimate augmented Phillips Curve
. * construct difference in inflation
. gen inflation_1=inflation[_n-1]
(1 missing value generated)

. gen d_inf=inflation-inflation_1
(1 missing value generated)

.

. reg d_inf unemp

      Source |       SS           df          MS
Model | 21.645692        1  21.645692
Residual | 333.612884       58  5.75194628
Total | 355.258576       59  6.0213318

Number of obs = 60
F( 1, 58) = 3.76
Prob > F = 0.0573
R-squared = 0.0609
Adj R-squared = 0.0447
Root MSE = 2.3983

      d_inf |   Coef.  Std. Err.      t    P>|t| [95% Conf. Interval]
unemp | -.4126824 .2127343 -1.94 0.057 -.8385164 .0131517
_cons | 2.116596 1.229603 1.72 0.091 -.3447227 4.577914

.

. estat dwatson
Durbin-Watson d-statistic( 2, 60) = 1.546911

```

19

Lag inflation

1st Difference in inflation

Identified time series ar(k) correction procedure

Corcram-Orcutt procedure

prais d_inf unemp, corc twostep

Same model statement
As before

20

```

.prais d_inf unemp, corc twostep
Iteration 0: rho = 0.0000
Iteration 1: rho = 0.1559

Cochrane-Orcutt AR(1) regression -- twostep estimates

Source |      SS        df       MS
Model | 34.338162     1 34.338162
Residual | 274.681638    57  4.8189761
Total | 309.0198    58  5.32792758

Number of obs =      59
F( 1, 57) =   7.13
Prob > F = 0.0099
R-squared = 0.1111
Adj R-squared = 0.0955
Root MSE = 2.1952

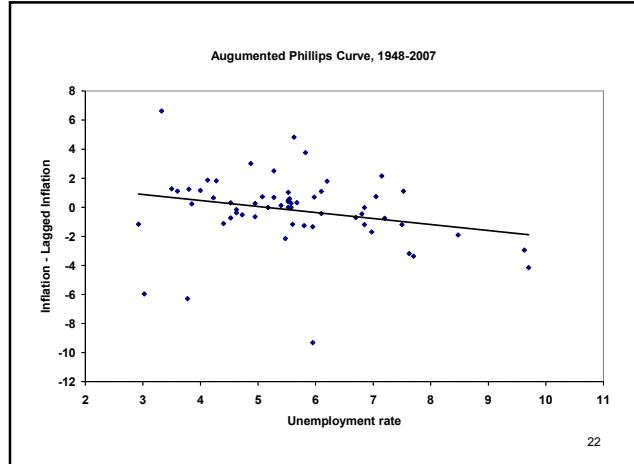
d_inf | Coef. Std. Err. t P>|t| [95% Conf. Interval]
unemp | -.5934445 .2223151 -2.67 0.010 -1.038623 -.1482662
cons | 3.269425 1.296032 2.52 0.014 .6741659 5.864685
rho | .1559494

Durbin-Watson statistic (original) 1.546911
Durbin-Watson statistic (transformed) 1.978150

```

**Adjusting for ar(1) changes
Results some**

21



Taylor Rule

$$i_t = \pi_t + r_t + a_n(\pi_t - \pi_t^*) + a_y(y_t - \hat{y}_t)$$

$$i_t = r_t - a_n\pi_t^* + (1+a_n)\pi_t + a_y(y_t - \hat{y}_t)$$

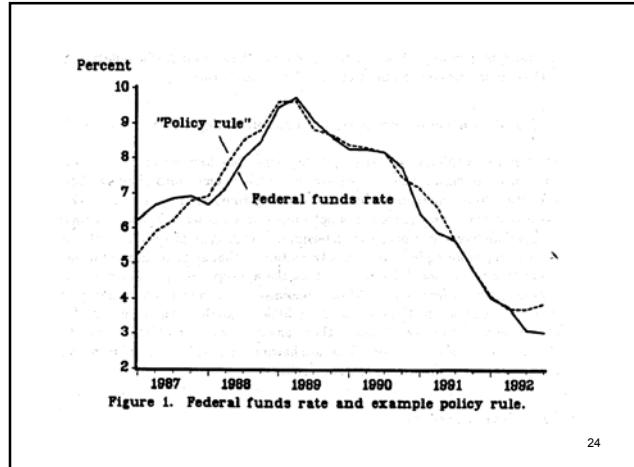
let $\pi_t^* = 2$ percent

$r_t = 2$ percent

Taylor suggests $a_n = a_y = 0.5$

$$i_t = 1 + 1.5\pi_t + 0.5(y_t - \hat{y}_t)$$

23



```

• * index the data for time series use
• tsset index

• *generate ln(gdp)
• gen gdprl=ln(gdp_r)
• label var gdprl "ln of real gdp"

• *get lag of fed fund rate
• * will use later
• gen ffri=ffr[_n-1]
• label var ffri "lag of fed fund rate"

• *get lag of gdprl
• * will use later
• gen gdprll=gdprl[_n-1]
• label var gdprll "lag of gdprl"

```

25

```

• * generate 1 year inflation
• * by taking difference between current
• * and a 4 period lag
• * report in percent
• gen gdp_def4=gdp_def[_n-4]
• gen inflation=100*(ln(gdp_def)-
    ln(gdp_def4))
• label var inflation "one-year inflation
    rate in percent"
• * reduce the data to the post-Greenspan
    years
• keep if year>=1987

```

26

```

• run a regression of gdprl on a trend
reg gdprl index

Source |      SS       df      MS
Number of obs =     86
Model | 2.91287537   1  2.91287537
Residual | .022637942  84 .000269499
Total | 2.93551331  85 .034535451

gdprl |   Coef.  Std. Err.      t    P>|t|   [95% Conf. Interval]
index | .0074137  .0000713  103.96  0.000   .0072719  .0075555
_cons | 8.253915  .0081458 1013.28  0.000   8.237716  8.270113

output residuals (output gap)
predict gdprl_res, residuals

scale gap in percent by
* multiplying by 100
gen gap=100*gdprl_res

```

27

```

• run taylor rule regression
reg ffr inflation gap

Source |      SS       df      MS
Number of obs =     86
F( 2,    83) =  19.78
Model | 125.327921   2  62.6639604
Prob > F      =  0.0000
Residual | 262.987021  83 3.16851832
R-squared      =  0.9923
Adj R-squared =  0.9922
Total | 388.314942  85 4.56841108
Root MSE      =  1.78

ffr |   Coef.  Std. Err.      t    P>|t|   [95% Conf. Interval]
inflation | 1.120342  .2535686  4.42  0.000   .6160043  1.62468
gap | .5149623  .1183526  4.35  0.000   .2795636  .7503609
_cons | 2.06164  .6535725  3.15  0.002   .7617106  3.361569

estat dwatson
Durbin-Watson d-statistic( 3,     86) = .0693391

```

28

```

. estat dwatson
Durbin-Watson d-statistic( 3, 86) = .0693391

. * test the taylor rule parameters using
. * an f-test
. test (gap=0.5) (inflation=1.5) (_cons=1.0)
( 1) gap = .5
( 2) inflation = 1.5
( 3) _cons = 1

F( 3, 83) = 0.89
Prob > F = 0.4480

```

29

Table A-2
Models with an intercept (from Savin and White)

Durbin-Watson Statistic: 5 Per Cent Significance Points of dL and dU

	k=1		k=2		k=3		k=4		k=5		k=6		k=7		k=8		k=9		k=10	
n	dL	dU																		
30	1.353	1.489	1.284	1.567	1.214	1.650	1.148	1.738	1.071	1.833	1.088	1.681	0.926	1.034	0.854	2.141	0.781	0.251	0.713	2.345
31	1.563	1.496	1.297	1.570	1.226	1.650	1.160	1.735	1.090	1.825	1.020	1.620	0.950	1.018	0.879	2.120	0.810	0.226	0.741	2.333
32	1.373	1.592	1.309	1.574	1.244	1.650	1.177	1.732	1.109	1.819	1.041	1.609	0.972	1.004	0.904	2.102	0.836	0.203	0.769	2.306
33	1.383	1.598	1.311	1.577	1.258	1.651	1.193	1.730	1.127	1.813	1.061	1.609	0.984	1.001	0.927	2.085	0.851	0.211	0.796	2.331
34	1.393	1.514	1.381	1.580	1.371	1.652	1.206	1.728	1.144	1.808	1.079	1.691	1.015	1.871	0.950	2.069	0.885	0.161	0.821	2.337
35	1.402	1.519	1.343	1.584	1.383	1.653	1.222	1.726	1.159	1.803	1.097	1.884	1.034	1.867	0.971	2.054	0.908	1.144	0.845	2.356
36	1.411	1.525	1.354	1.587	1.395	1.654	1.236	1.724	1.175	1.799	1.114	1.876	1.053	1.857	0.991	2.041	0.930	2.127	0.884	2.316
37	1.419	1.530	1.361	1.590	1.307	1.655	1.249	1.723	1.175	1.795	1.131	1.870	1.071	1.841	1.011	2.029	0.951	2.111	0.891	2.307
38	1.427	1.539	1.373	1.594	1.318	1.656	1.261	1.722	1.204	1.793	1.146	1.864	1.088	1.893	1.059	2.017	0.970	2.094	0.891	2.335
39	1.435	1.540	1.382	1.597	1.328	1.658	1.273	1.722	1.218	1.789	1.161	1.859	1.103	1.932	1.047	2.007	0.980	2.085	0.932	2.354
40	1.442	1.544	1.391	1.600	1.338	1.659	1.285	1.721	1.230	1.785	1.175	1.854	1.120	1.924	1.064	1.997	1.008	2.071	0.952	2.349
45	1.475	1.568	1.419	1.615	1.383	1.666	1.336	1.720	1.287	1.776	1.238	1.835	1.189	1.880	1.139	1.938	1.089	2.021	1.063	2.638
50	1.503	1.586	1.436	1.625	1.408	1.674	1.376	1.721	1.371	1.771	1.301	1.832	1.246	1.871	1.201	1.939	1.156	1.984	1.110	2.611
55	1.518	1.601	1.460	1.641	1.452	1.681	1.414	1.724	1.374	1.798	1.334	1.814	1.284	1.861	1.253	1.909	1.212	1.959	1.170	2.610
60	1.548	1.620	1.471	1.650	1.469	1.689	1.430	1.725	1.408	1.797	1.372	1.835	1.320	1.882	1.289	1.940	1.250	1.985	1.222	1.954
65	1.567	1.630	1.484	1.667	1.481	1.697	1.451	1.729	1.471	1.801	1.437	1.866	1.350	1.941	1.346	1.931	1.303	1.915	1.265	1.954
70	1.583	1.641	1.554	1.672	1.525	1.703	1.404	1.735	1.454	1.768	1.431	1.802	1.401	1.838	1.369	1.974	1.337	1.910	1.295	1.948
75	1.600	1.662	1.571	1.683	1.545	1.716	1.485	1.750	1.485	1.774	1.468	1.801	1.428	1.834	1.399	1.947	1.405	1.939	1.359	1.949
80	1.611	1.682	1.595	1.688	1.560	1.715	1.534	1.743	1.507	1.772	1.480	1.801	1.453	1.831	1.425	1.861	1.397	1.893	1.369	1.952

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.prais ffr inflation gap, core twostep

Iteration 0: rho = 0.0000
Iteration 1: rho = 0.9643

Cochrane-Orcutt AR(1) regression -- twostep estimates

Source | SS df MS Number of obs = 85
        | 4.47345645 2 2.2367282 F( 2, 82) = 11.23
Model | 16.3318273 82 .199168626 Prob > F = 0.0000
Residual | 20.8052838 84 .24768195 R-squared = 0.2150
Total | 20.8052838 84 .24768195 Adj R-squared = 0.1959
Root MSE = .44628

ffr | Coef. Std. Err. t P>|t| [95% Conf. Interval]
inflation | -.7559721 .2229863 3.39 0.001 .3123813 1.199563
gap | .3110593 .0930983 3.34 0.001 .1258571 .4962616
_cons | 1.878748 1.450736 1.30 0.199 -1.007228 4.764725

rho | .9642664

Durbin-Watson statistic (original) 0.069339
Durbin-Watson statistic (transformed) 0.926851

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