Goethe-Universität Frankfurt
Statistik und Methoden der Ökonometrie
Prof. Dr. Uwe Hassler
Finanzökonometrie Sommersemester 2007

1. Übung: Einführung in EVIEWS

Kreieren Sie eine Arbeitsumgebung (*workfile*) und erzeugen Sie zeitlich unabhängige Pseudozufallszahlen $\varepsilon_t \sim \mathcal{N}(0, \sigma^2)$, $t = 1, \ldots, T$, mit dem Befehl *genr eps=nrnd*$*\sigma$ (z. B. $\sigma^2 = 1$ und $T = 500$).

a) Betrachten Sie den Graphen, das Autokorrelogramm und das Histogramm von ε_t.

b) Simulieren Sie eine Martingaldifferenz wie folgt:

$$y_t = \varepsilon_t \varepsilon_{t-1}\,, \quad t = 2, \ldots, T\,. \tag{1}$$

Betrachten Sie den Graphen, das Autokorrelogramm und das Histogramm von y_t.

c) Simulieren Sie den Prozess y_t mit einem linearen Zeittrend im Mittel:

$$y_t = 10 + 0.5\,t + \varepsilon_t\,, \quad t = 1, \ldots, T\,. \tag{2}$$

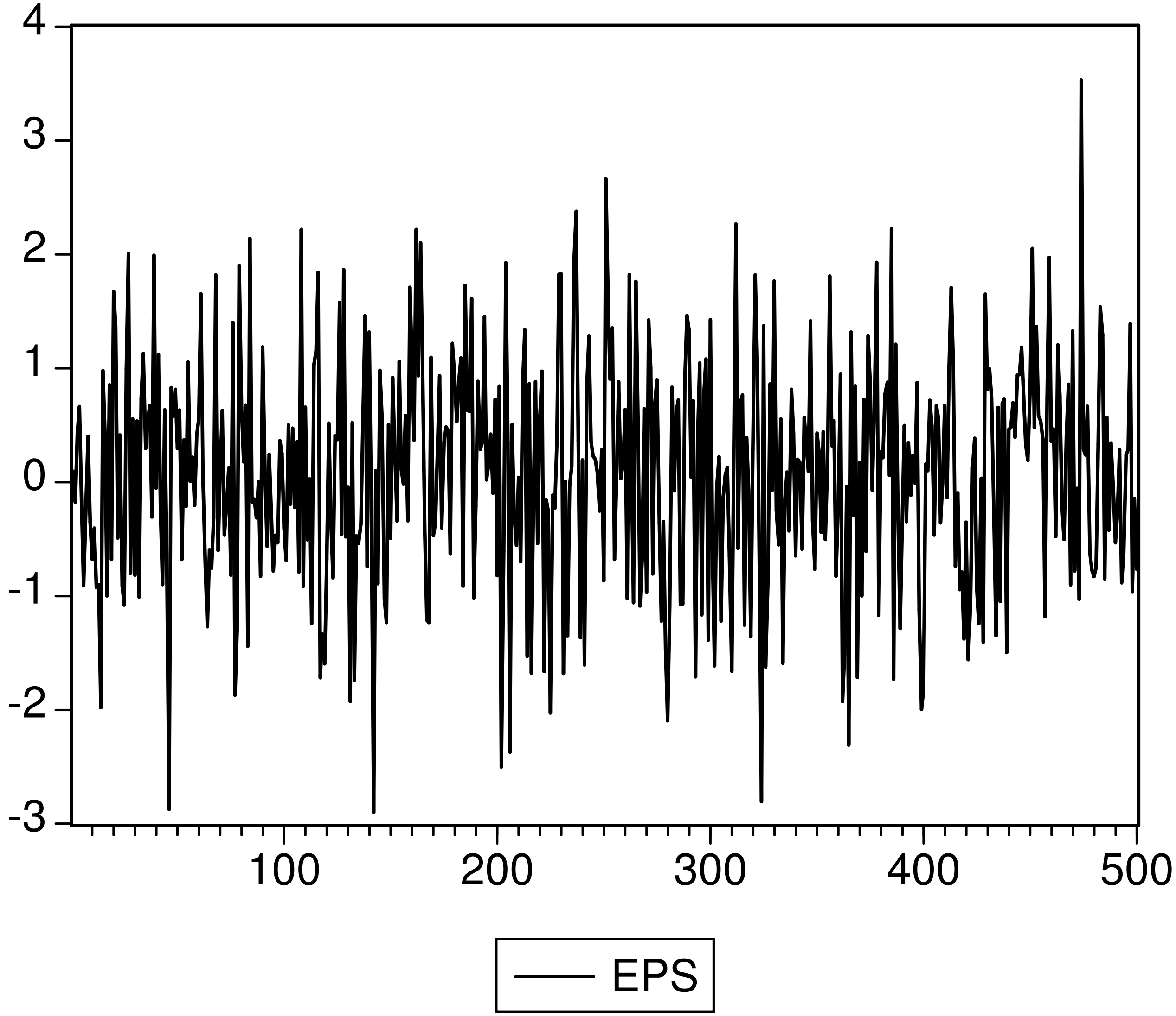
Schätzen Sie nach der KQ-Methode

$$y_t = \widehat{a} + \widehat{b}\,t + \widehat{\varepsilon}_t\,.$$

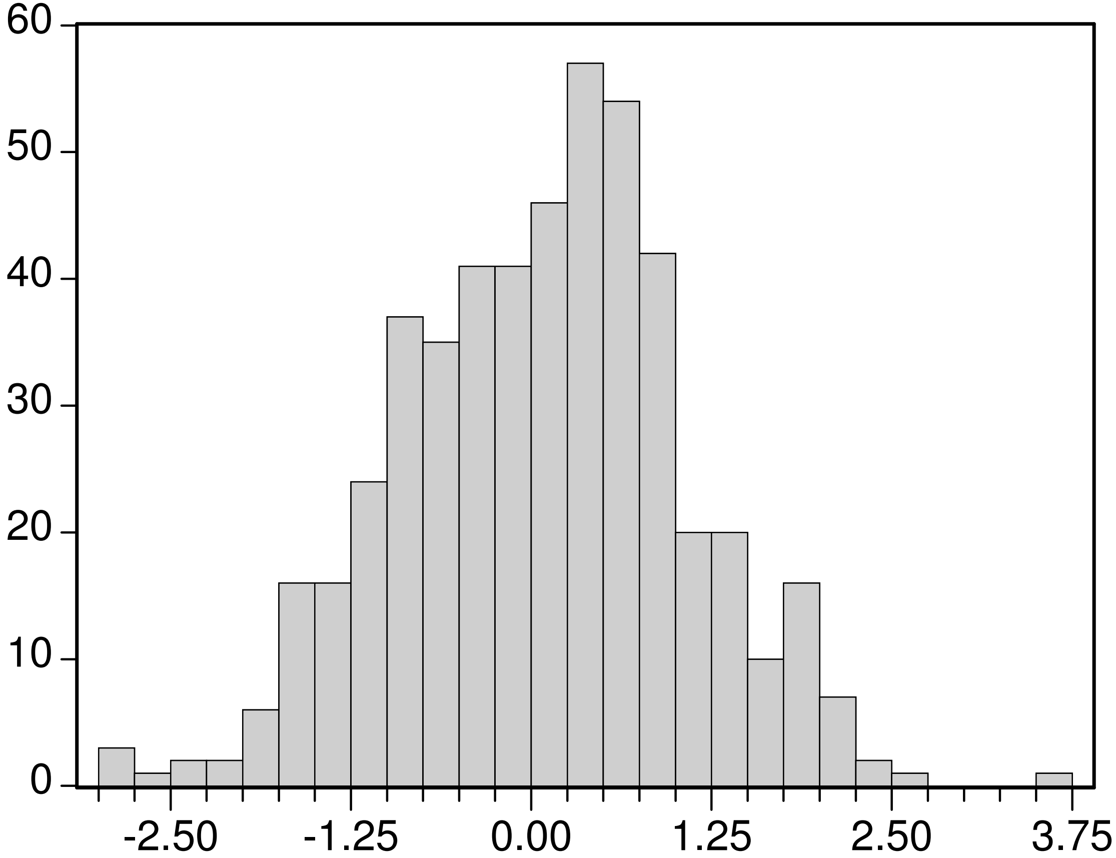
Was für Schätzwerte und Standardfehler erhalten Sie? Vergleichen Sie die Residuen $\widehat{\varepsilon}_t$ mit den Fehlern ε_t.

d) Machen Sie sich klar, dass Ihre Ergebnisse von der konkreten Zufallswahl von ε_t abhängen. Wiederholen Sie also spaßeshalber die Experimente aus a) bis c) mit neu erzeugten Zufallszahlen.

a) EPS_t- Graph



a) EPS_t - Histogramm



Series: EPS
Sample 1 500
Observations 500

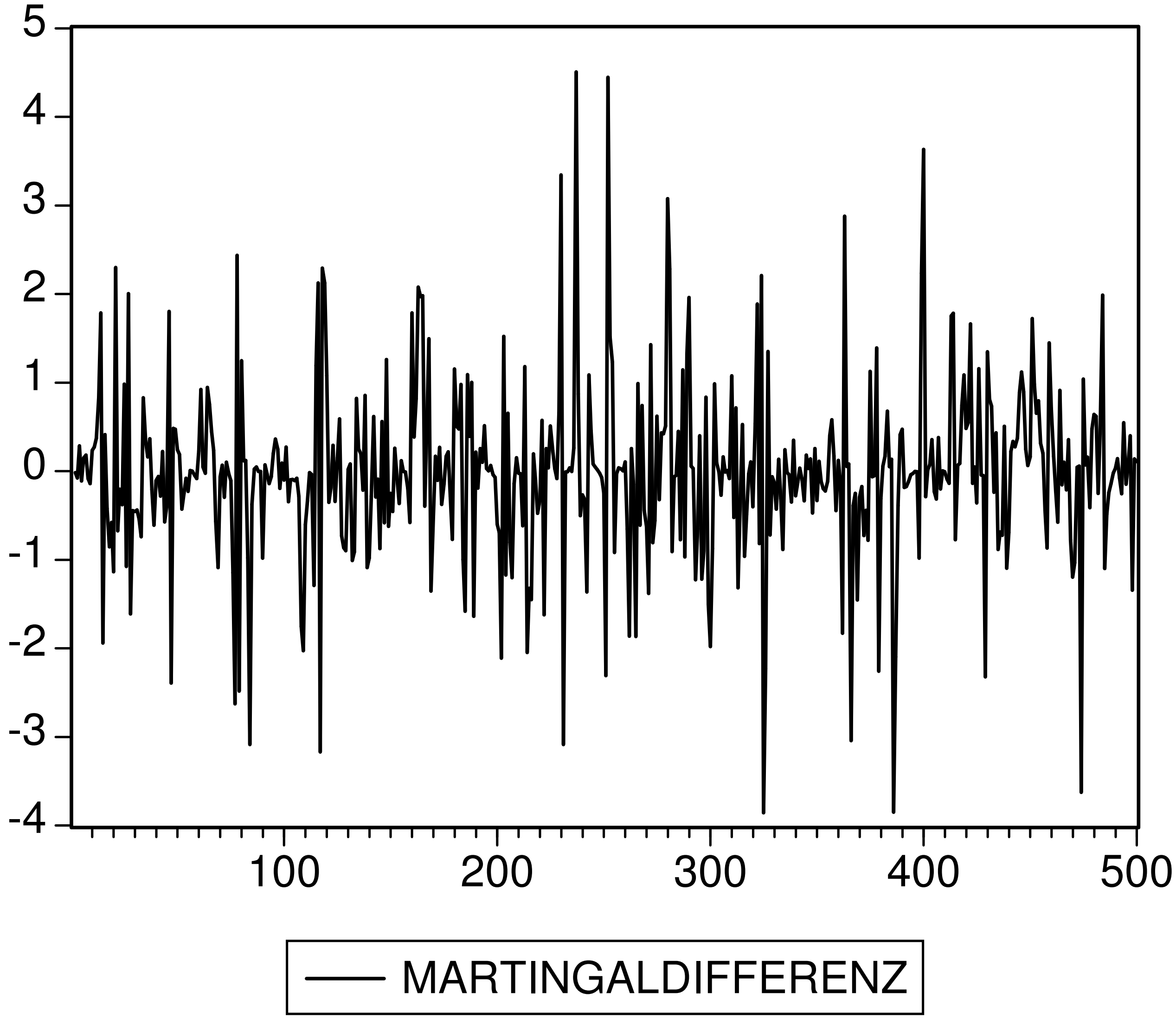
Mean	0.076899
Median	0.138938
Maximum	3.532416
Minimum	-2.899905
Std. Dev.	0.992984
Skewness	-0.076756
Kurtosis	3.046274
Jarque-Bera	0.535563
Probability	0.765075

a) EPS_t - Korrelogramm

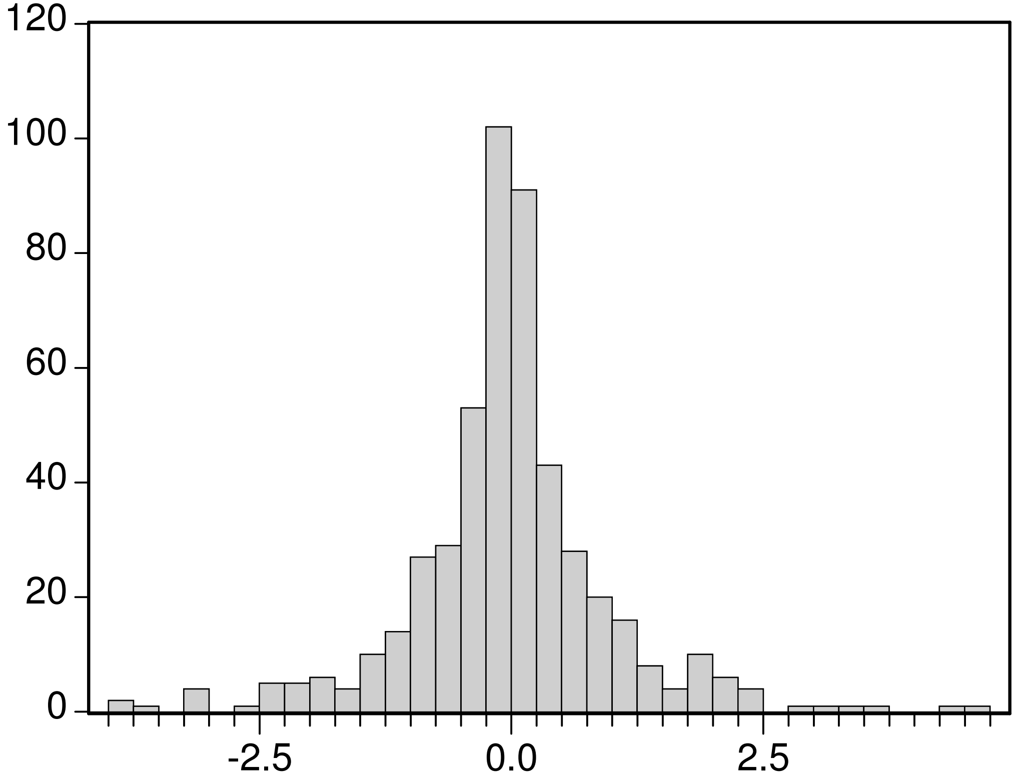
Date: 05/19/07 Time: 12:12
Sample: 1 500
Included observations: 500

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	-0.024	-0.024	0.2898	0.590
		2	0.025	0.025	0.6076	0.738
		3	0.050	0.051	1.8473	0.605
		4	-0.128	-0.127	10.159	0.038
		5	-0.051	-0.060	11.457	0.043
		6	0.130	0.136	20.097	0.003
		7	-0.084	-0.065	23.661	0.001
		8	0.145	0.127	34.428	0.000
		9	0.002	-0.016	34.431	0.000
		10	-0.001	0.028	34.431	0.000
		11	0.029	0.015	34.875	0.000
		12	-0.095	-0.093	39.563	0.000
		13	-0.017	0.014	39.713	0.000
		14	0.068	0.035	42.084	0.000
		15	-0.117	-0.088	49.160	0.000
		16	0.031	-0.012	49.670	0.000
		17	0.057	0.049	51.362	0.000
		18	-0.015	0.029	51.484	0.000
		19	0.035	-0.003	52.139	0.000
		20	-0.045	-0.054	53.206	0.000
		21	-0.047	-0.002	54.359	0.000
		22	0.056	0.043	55.996	0.000
		23	0.042	0.071	56.928	0.000
		24	0.048	0.034	58.166	0.000
		25	0.006	-0.029	58.185	0.000
		26	-0.045	-0.023	59.255	0.000
		27	-0.067	-0.084	61.667	0.000
		28	-0.037	-0.027	62.399	0.000
		29	0.013	0.043	62.485	0.000
		30	0.017	-0.006	62.642	0.000
		31	-0.027	-0.055	63.026	0.001
		32	0.037	0.016	63.744	0.001
		33	0.006	0.024	63.761	0.001
		34	-0.092	-0.076	68.341	0.000
		35	0.034	0.033	68.956	0.001
		36	0.059	0.084	70.870	0.000

b) Martingaldifferenz - Graph



b) Martingaldifferenz - Histogramm

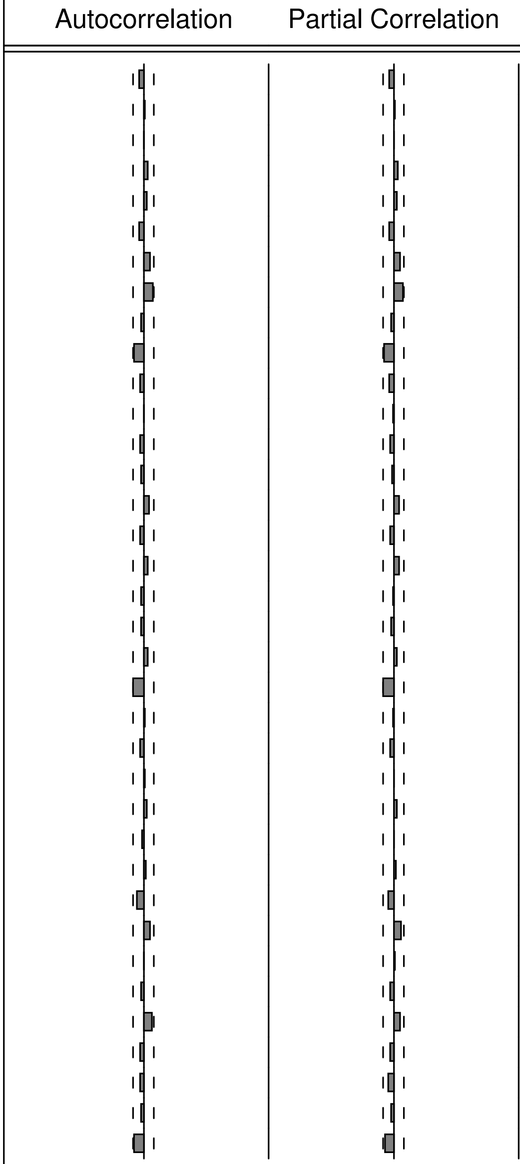


Series: MARTINGALDIFFERENZ
Sample 2 500
Observations 499

Mean	-0.017627
Median	-0.014281
Maximum	4.507043
Minimum	-3.853783
Std. Dev.	0.994790
Skewness	0.122946
Kurtosis	6.559713
Jarque-Bera	264.7199
Probability	0.000000

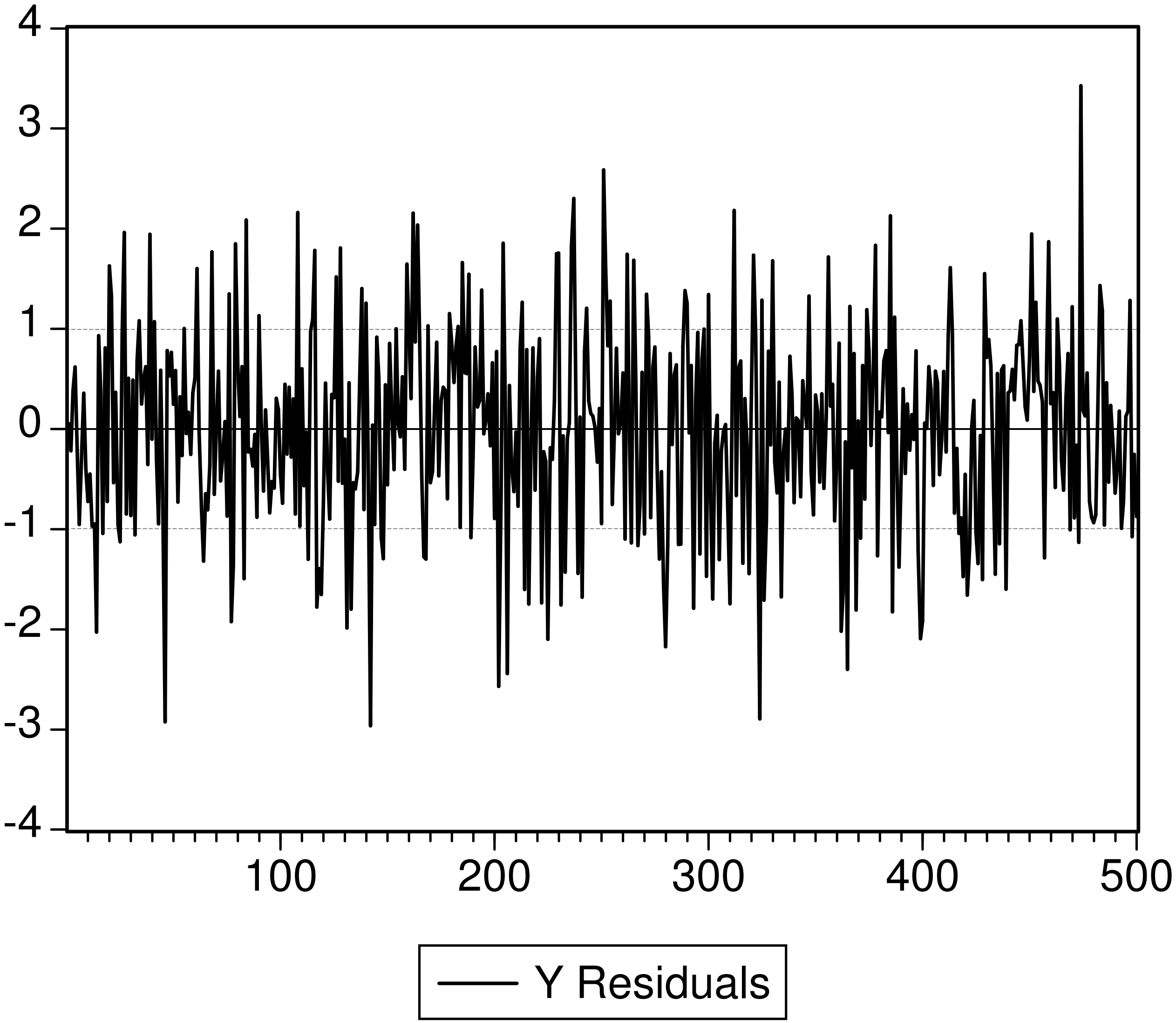
b) Martingaldifferenz - Korrelogramm

Date: 05/19/07 Time: 12:21
Sample: 1 500
Included observations: 499

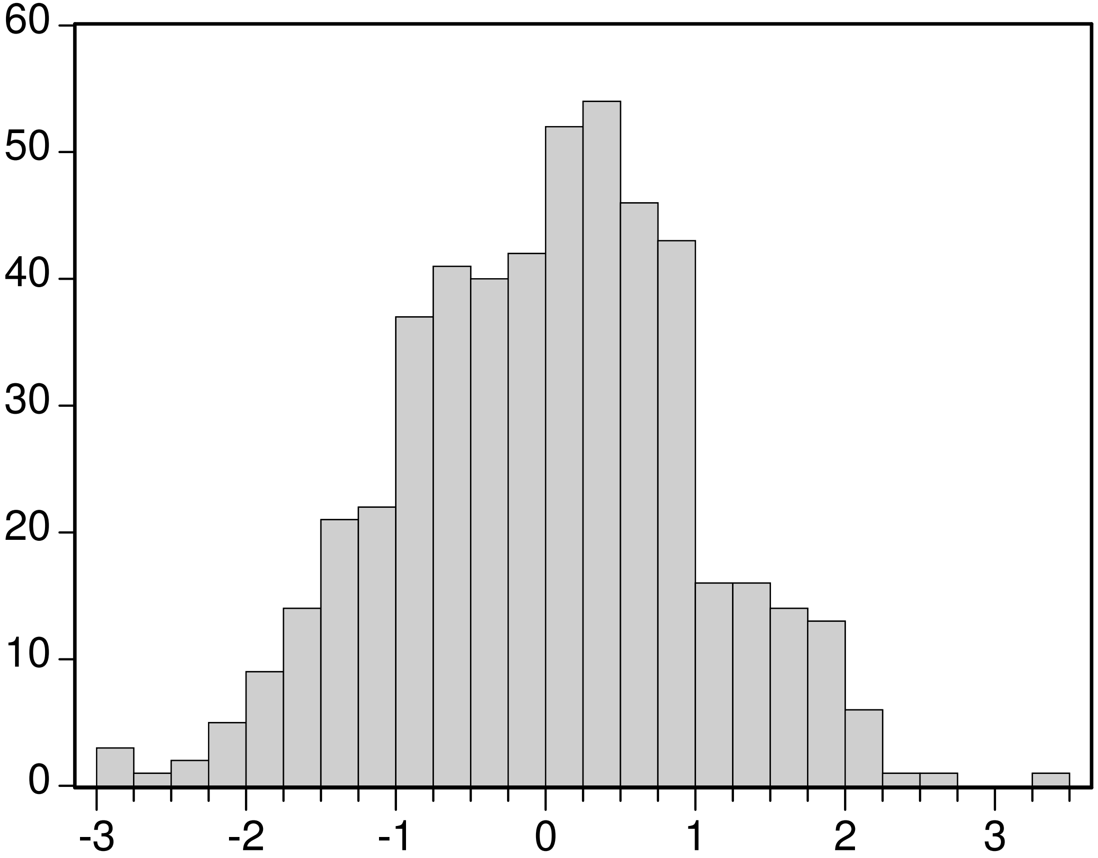


	AC	PAC	Q-Stat	Prob
1	-0.038	-0.038	0.7075	0.400
2	0.013	0.011	0.7895	0.674
3	0.005	0.006	0.8010	0.849
4	0.035	0.035	1.4263	0.840
5	0.029	0.032	1.8551	0.869
6	-0.036	-0.035	2.5225	0.866
7	0.055	0.052	4.0772	0.771
8	0.074	0.078	6.8819	0.549
9	-0.019	-0.017	7.0744	0.629
10	-0.074	-0.077	9.8633	0.453
11	-0.031	-0.039	10.341	0.500
12	0.005	-0.005	10.354	0.585
13	-0.031	-0.029	10.842	0.624
14	-0.021	-0.015	11.059	0.681
15	0.043	0.041	12.036	0.676
16	-0.028	-0.031	12.436	0.713
17	0.037	0.046	13.158	0.726
18	-0.024	-0.002	13.460	0.764
19	-0.016	-0.020	13.602	0.806
20	0.033	0.027	14.181	0.821
21	-0.088	-0.084	18.198	0.636
22	0.009	-0.007	18.241	0.692
23	-0.025	-0.027	18.573	0.726
24	0.009	0.003	18.615	0.772
25	0.025	0.030	18.949	0.800
26	-0.012	0.000	19.025	0.835
27	0.023	0.023	19.307	0.859
28	-0.055	-0.047	20.933	0.828
29	0.057	0.061	22.675	0.791
30	0.005	0.012	22.687	0.828
31	-0.017	-0.025	22.846	0.855
32	0.067	0.053	25.254	0.796
33	-0.029	-0.030	25.708	0.813
34	-0.025	-0.044	26.048	0.834
35	-0.022	-0.019	26.319	0.855
36	-0.077	-0.072	29.497	0.770

c) Graph - Schätzfehler



c) Histogramm - Schätzfehler



Series: Residuals
Sample 1 500
Observations 500

Mean	1.08E-14
Median	0.062237
Maximum	3.425944
Minimum	-2.962448
Std. Dev.	0.992800
Skewness	-0.076745
Kurtosis	3.040264
Jarque-Bera	0.524589
Probability	0.769284

c) Korrelogramm - Schätzfehler

Date: 05/19/07 Time: 12:44
Sample: 1 500
Included observations: 500

	AC	PAC	Q-Stat	Prob
1	-0.024	-0.024	0.3005	0.584
2	0.025	0.024	0.6077	0.738
3	0.049	0.050	1.8220	0.610
4	-0.129	-0.127	10.203	0.037
5	-0.051	-0.060	11.525	0.042
6	0.130	0.135	20.121	0.003
7	-0.084	-0.065	23.723	0.001
8	0.145	0.127	34.424	0.000
9	0.002	-0.017	34.426	0.000
10	-0.001	0.028	34.427	0.000
11	0.029	0.014	34.857	0.000
12	-0.096	-0.094	39.587	0.000
13	-0.017	0.014	39.743	0.000
14	0.068	0.034	42.102	0.000
15	-0.117	-0.088	49.211	0.000
16	0.031	-0.012	49.711	0.000
17	0.057	0.049	51.394	0.000
18	-0.015	0.029	51.518	0.000
19	0.035	-0.003	52.172	0.000
20	-0.045	-0.054	53.250	0.000
21	-0.047	-0.002	54.422	0.000
22	0.055	0.043	56.038	0.000
23	0.042	0.071	56.950	0.000
24	0.048	0.034	58.170	0.000
25	0.006	-0.029	58.188	0.000
26	-0.045	-0.023	59.273	0.000
27	-0.068	-0.084	61.704	0.000
28	-0.037	-0.027	62.445	0.000
29	0.012	0.042	62.528	0.000
30	0.017	-0.006	62.679	0.000
31	-0.027	-0.055	63.070	0.001
32	0.036	0.015	63.780	0.001
33	0.005	0.024	63.796	0.001
34	-0.093	-0.076	68.406	0.000
35	0.033	0.032	69.009	0.001
36	0.059	0.083	70.901	0.000

c) KQ-Methode

Dependent Variable: Y
Method: Least Squares
Date: 05/19/07 Time: 12:36
Sample: 1 500
Included observations: 500

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	10.04375	0.089021	112.8241	0.0000
T	0.500132	0.000308	1624.243	0.0000

R-squared	0.999811	Mean dependent var	135.3269
Adjusted R-squared	0.999811	S.D. dependent var	72.26685
S.E. of regression	0.993796	Akaike info criterion	2.829423
Sum squared resid	491.8403	Schwarz criterion	2.846282
Log likelihood	-705.3558	F-statistic	2638166.
Durbin-Watson stat	2.047324	Prob(F-statistic)	0.000000

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2. Übung: Differenzen und Lag-Polynome

a) Betrachten Sie die Differenzengleichung erster Ordnung,

$$x_t = a\, x_{t-1}\,, \quad t = 1, 2, \ldots\,. \tag{1}$$

- Wie lautet die Lösung x_t^*, welche (1) für alle Zeitpunkte und den Startwert x_0 erfüllt?
- Unterstellen Sie nun $|a| < 1$. Zeigen Sie, dass dann diese Lösung absolut summierbar ist, und bestimmen Sie den Wert von $\sum_{t=1}^{\infty} |x_t^*|$.

b) Betrachten Sie mit dem Lag-Operator L die Differenzen $\Delta = 1 - L$ und $\Delta_4 = 1 - L^4$. Wie wirkt sich deren Hintereinanderschaltung aus? M.a.W.: Bestimmen Sie

$$\Delta\Delta_4 x_t \quad \text{und} \quad \Delta_4\Delta x_t\,.$$

Bestimmen Sie auch den Effekt doppelter Differenzenbildung: $\Delta^2 x_t$.

c) Betrachten Sie den Filter $A(L) = 1 - aL$ für $|a| < 1$. Zeigen Sie, dass er invertierbar ist, d. h. dass eine Reihenentwicklung

$$\frac{1}{1 - aL} = \sum_{j=0}^{\infty} \alpha_j L^j$$

existiert mit $\sum_{j=0}^{\infty} |\alpha_j| < \infty$.

Hinweis: Zeigen Sie dazu $\alpha_j = a^j$.

Finanzökonometrie **SS 07**
Prof. Dr. Hassler
2. Übung

a)

$$\textit{gesucht wird eine Gleichung für } x_t^* \textit{ bei der folgende Beziehung gilt:}$$
$$x_t = a \cdot x_{t-1}$$
$$\textit{also:}$$
$$x_0 = 1 \cdot x_0 = a^0 \cdot x_0$$
$$x_1 = a \cdot x_0 = a^1 \cdot x_0$$
$$x_2 = a \cdot x_1 = a \cdot a \cdot x_0 = a^2 \cdot x_0$$
$$x_3 = a \cdot x_2 = a \cdot a^2 \cdot x_0 = a^3 \cdot x_0$$
$$x_4 = a \cdot x_3 = a \cdot a^3 \cdot x_0 = a^4 \cdot x_0$$
$$\vdots$$
$$x_t = a \cdot a^{t-1} \cdot x_0 = a^t \cdot x_0$$
$$\textit{Lösung: } x_t^* = a^t \cdot x_0$$

$$\lim_{t\to\infty} x_t^* = \lim_{t\to\infty} a^t \cdot x_0 = 0 \Leftrightarrow |a| < 1$$

b)

$$\Delta = 1 - L;\ \Delta_4 = 1 - L^4$$
$$\Delta \Delta_4 x_t = (1-L^1)\cdot(1-L^4)\cdot x_t = (1-L-L^4+L^5)\cdot x_t = x_t - x_{t-1} - x_{t-4} + x_{t-5}$$
$$\Delta_4 \Delta x_t = (1-L^4)\cdot(1-L^1)\cdot x_t = (1-L^4-L+L^5)\cdot x_t = x_t - x_{t-4} - x_{t-1} + x_{t-5}$$
$$\textit{Lösung: } \Delta_4 \Delta x_t = \Delta \Delta_4 x_t$$
$$\textit{Der Differenzenoperator ist kommutativ, daher ist die Reihenfolge irrelevant!}$$

$$\Delta^2 x_t = (1-L)\cdot(1-L)\cdot x_t = (1-2\mathrm{L}+L^2)\cdot x_t = x_t - 2\cdot x_{t-1} + x_{t-2}$$

c)

$$\frac{1}{1-aL} = \sum_{j=0}^{\infty} \alpha_j L^j$$
$$\Leftrightarrow L^0 = 1 = (1-aL)\cdot \sum_{j=0}^{\infty} \alpha_j L^j$$
$$\Leftrightarrow L^0 = 1 = \alpha_0 L^0 + \alpha_1 L^1 + \alpha_2 L^2 + \cdots - a\alpha_0 L^1 - a\alpha_1 L^2 - a\alpha_2 L^3 - \cdots$$
$$\textit{Koeffizientenvergleich ergibt:}$$
$$L^0: \alpha_0 L^0 = L^0 = 1$$
$$L^1: \alpha_1 L^1 - a\alpha_0 L^1 = 0$$
$$L^2: \alpha_2 L^2 - a\alpha_1 L^2 = 0$$
$$\vdots$$

$$\Leftrightarrow$$

$$\alpha_0 = 1 = a^0$$
$$\alpha_1 - a\,\alpha_0 = 0$$
$$\alpha_2 - a\,\alpha_1 = 0$$
$$\vdots$$

$$\Leftrightarrow$$

$$\alpha_0 = a^0$$
$$\alpha_1 = a^1$$
$$\alpha_2 = a^2$$
$$\vdots$$
$$\alpha_j = a^j$$

q.e.d.

$$\Rightarrow \sum_{j=0}^{\infty} \alpha_j = \sum_{j=0}^{\infty} |a|^j = \frac{1}{1-|a|}$$

$$\text{für } |a|<1 \text{ hat die Summe } \sum_{j=0}^{\infty} |a|^j \text{ ein endliches Ergebnis ,}$$

somit existiert die Inverse des Lag − Ploynoms

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3. Übung: Simulation autoregressiver Prozesse

Kreieren Sie eine Arbeitsumgebung (*workfile*) und erzeugen Sie zeitlich unabhängige Pseudozufallszahlen $\varepsilon_t \sim \mathcal{N}(0,1)$, $t = 1, \ldots, T$ (z. B. $T = 1000$).

a) AR(1): Erzeugen Sie (für unterschiedliche Werte a)

$$x_t = a\,x_{t-1} + \varepsilon_t\,, \quad t = 2, \ldots, T\,.$$

Betrachten Sie das zugehörige *empirische* Autokorrelogramm. Wie sieht das *theoretische* Autokorrelogramm aus?

b) AR(2): Erzeugen Sie (für unterschiedliche Werte a_1 und a_2)

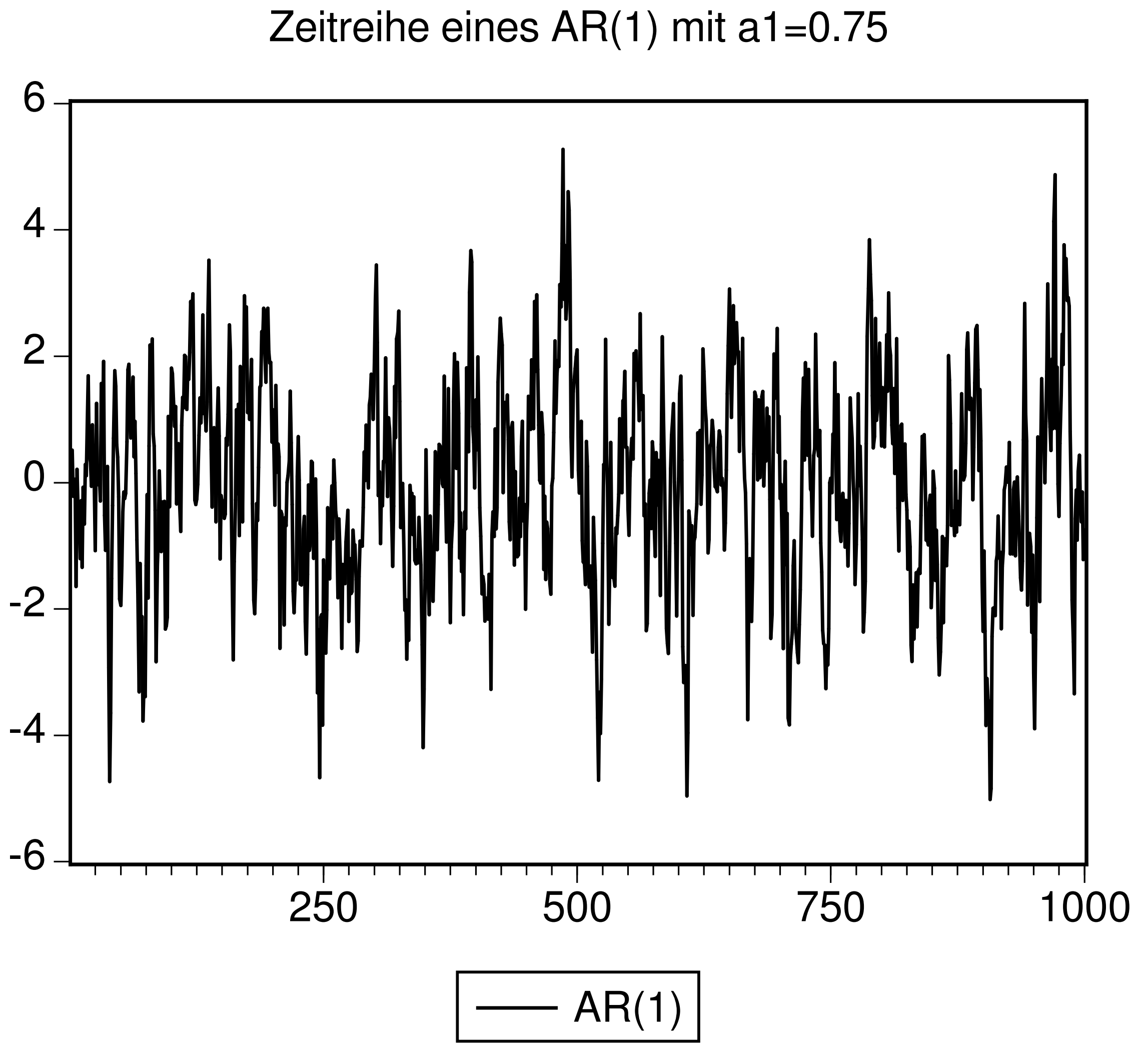
$$x_t = a_1\,x_{t-1} + a_2\,x_{t-2} + \varepsilon_t\,, \quad t = 3, \ldots, T\,.$$

Betrachten Sie das zugehörige *empirische* Autokorrelogramm. Wie sieht das *theoretische* Autokorrelogramm aus?

c) ARMA(1,1): Erzeugen Sie (für unterschiedliche Werte a und b)

$$x_t = a\,x_{t-1} + \varepsilon_t + b\,\varepsilon_{t-1}\,, \quad t = 2, \ldots, T\,.$$

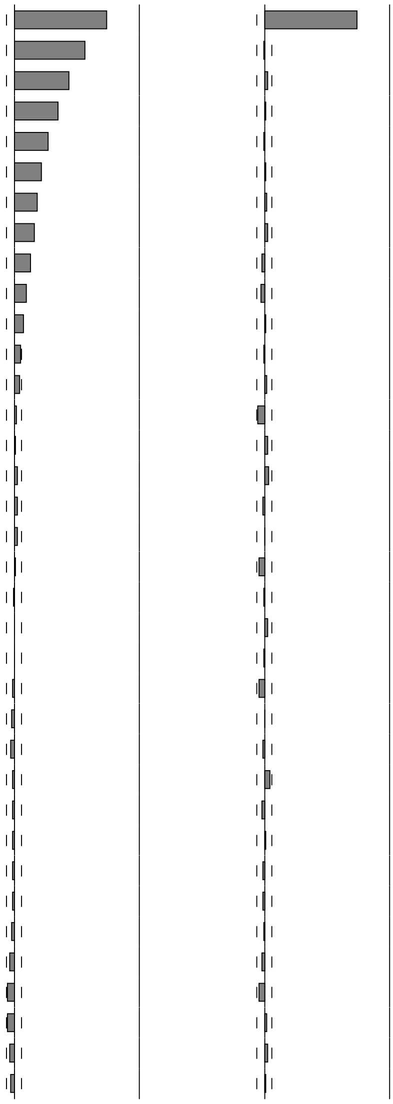
Betrachten Sie das zugehörige *empirische* Autokorrelogramm. Wie sieht das *theoretische* Autokorrelogramm aus?


Zeitreihe eines AR(1) mit a1=0.75
6
4
2
0
-2
-4
-6
250
500
750
1000
AR(1)

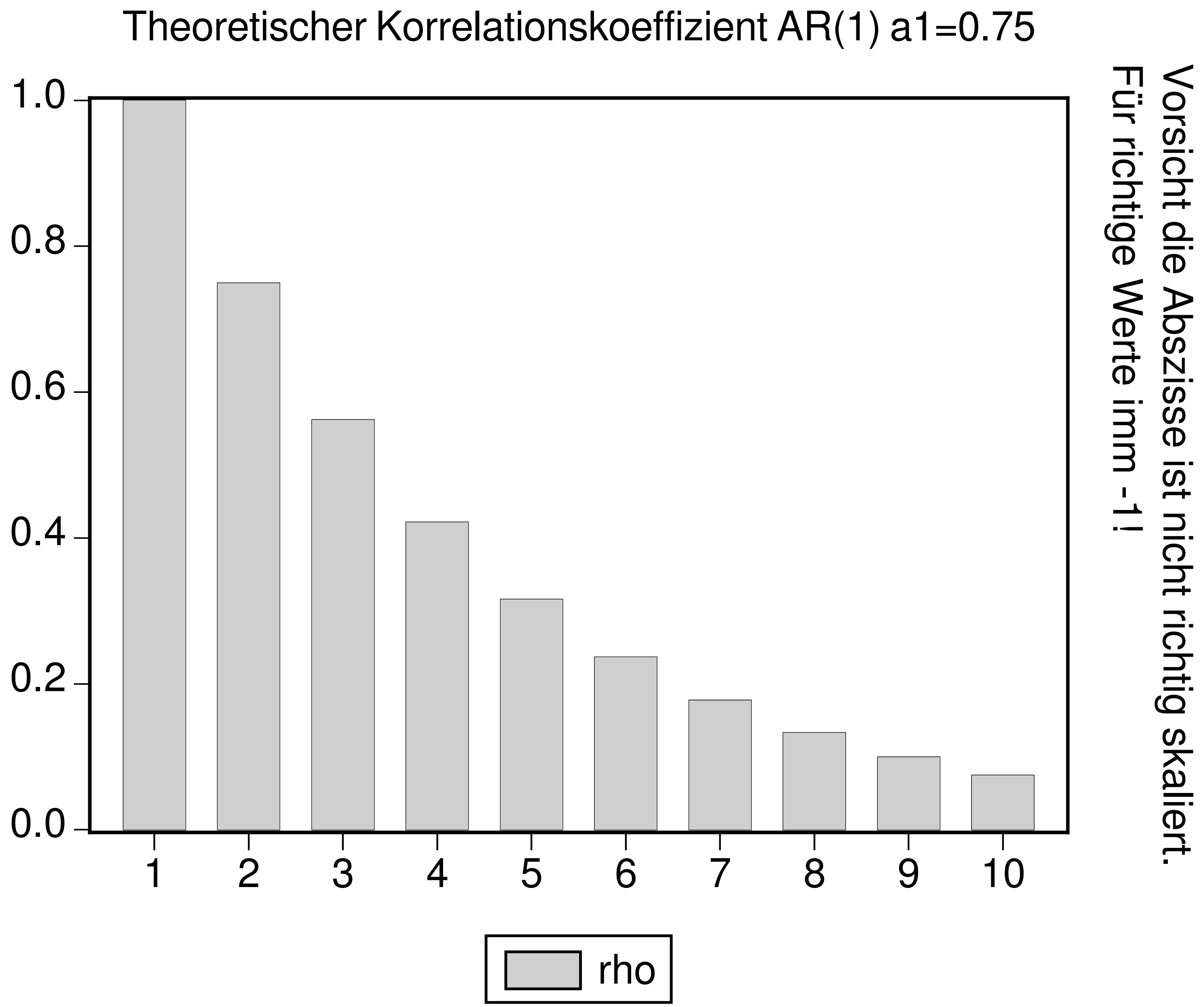
Korrelogramm eines AR(1) mit a1=0.75

Date: 08/05/07 Time: 11:12
Sample: 1 1000
Included observations: 1000

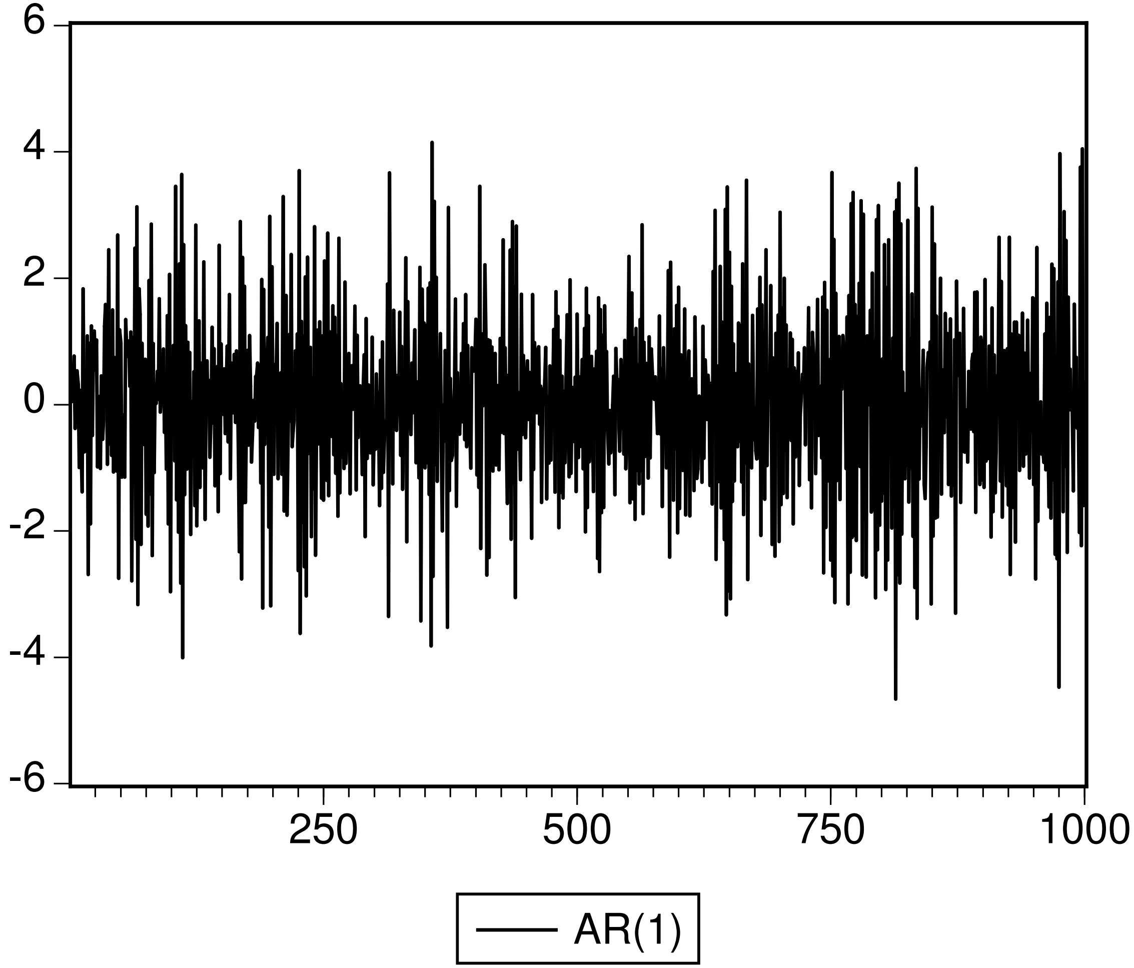
Autocorrelation | Partial Correlation



	AC	PAC	Q-Stat	Prob
1	0.767	0.767	589.70	0.000
2	0.586	-0.005	934.16	0.000
3	0.458	0.026	1145.3	0.000
4	0.362	0.009	1277.3	0.000
5	0.284	-0.004	1358.7	0.000
6	0.226	0.009	1410.3	0.000
7	0.189	0.021	1446.3	0.000
8	0.168	0.028	1474.9	0.000
9	0.137	-0.023	1493.9	0.000
10	0.099	-0.030	1503.8	0.000
11	0.076	0.010	1509.6	0.000
12	0.056	-0.008	1512.7	0.000
13	0.048	0.018	1515.0	0.000
14	0.019	-0.053	1515.3	0.000
15	0.013	0.031	1515.5	0.000
16	0.026	0.037	1516.2	0.000
17	0.028	-0.009	1517.1	0.000
18	0.028	0.004	1517.8	0.000
19	0.009	-0.042	1517.9	0.000
20	-0.003	-0.001	1517.9	0.000
21	0.004	0.030	1517.9	0.000
22	0.006	-0.000	1518.0	0.000
23	-0.013	-0.047	1518.2	0.000
24	-0.020	0.004	1518.6	0.000
25	-0.027	-0.014	1519.3	0.000
26	-0.013	0.042	1519.5	0.000
27	-0.014	-0.019	1519.7	0.000
28	-0.011	0.010	1519.8	0.000
29	-0.010	-0.012	1519.9	0.000
30	-0.015	-0.012	1520.2	0.000
31	-0.022	-0.008	1520.7	0.000
32	-0.034	-0.018	1521.8	0.000
33	-0.057	-0.048	1525.2	0.000
34	-0.056	0.021	1528.4	0.000
35	-0.040	0.030	1530.1	0.000
36	-0.030	0.009	1531.1	0.000

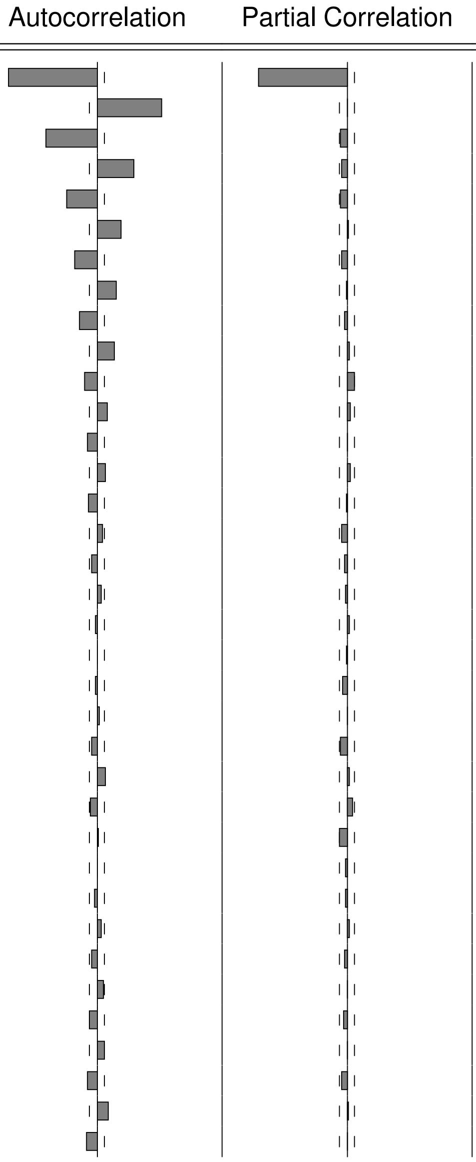

Theoretischer Korrelationskoeffizient AR(1) a1=0.75
1.0
0.8
0.6
0.4
0.2
0.0
1
2
3
4
5
6
7
8
9
10
rho
Vorsicht die Abszisse ist nicht richtig skaliert.
Für richtige Werte imm -1!

Korrelogramm eines AR(1) mit a1=-0.75

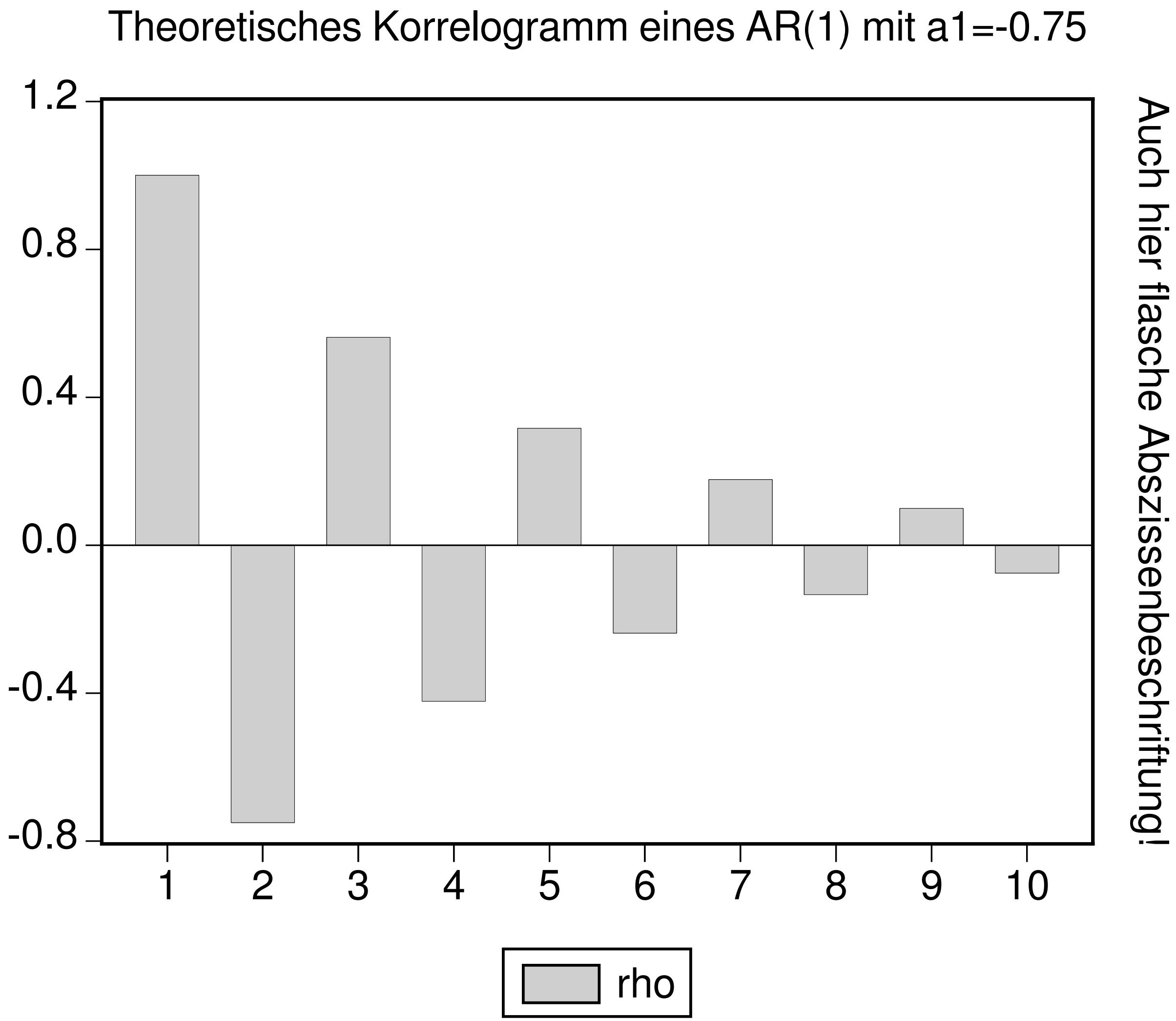


Korrelogramm eines AR(1) mit a1=-0.75

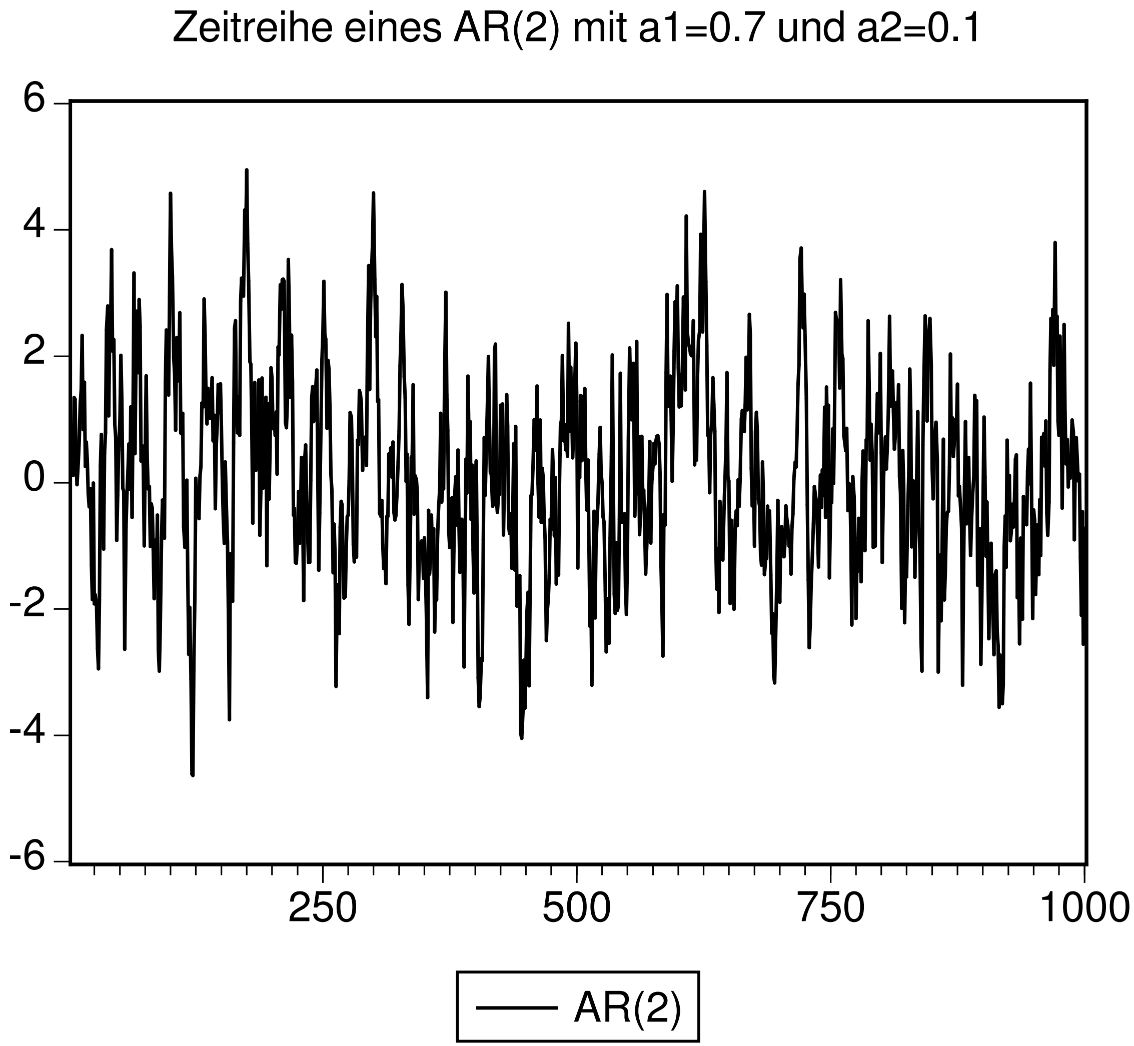
Date: 08/05/07 Time: 11:16
Sample: 2 1000
Included observations: 999



	AC	PAC	Q-Stat	Prob
1	-0.731	-0.731	535.49	0.000
2	0.538	0.007	825.36	0.000
3	-0.421	-0.055	1003.2	0.000
4	0.305	-0.048	1096.8	0.000
5	-0.246	-0.055	1157.8	0.000
6	0.203	0.009	1199.4	0.000
7	-0.184	-0.047	1233.5	0.000
8	0.162	-0.003	1259.9	0.000
9	-0.147	-0.024	1281.8	0.000
10	0.141	0.021	1302.0	0.000
11	-0.099	0.059	1311.8	0.000
12	0.085	0.032	1319.1	0.000
13	-0.074	0.002	1324.7	0.000
14	0.072	0.028	1330.0	0.000
15	-0.072	-0.002	1335.3	0.000
16	0.046	-0.042	1337.5	0.000
17	-0.043	-0.022	1339.3	0.000
18	0.033	-0.011	1340.5	0.000
19	-0.013	0.024	1340.6	0.000
20	0.004	-0.002	1340.7	0.000
21	-0.014	-0.037	1340.9	0.000
22	0.021	0.001	1341.3	0.000
23	-0.046	-0.054	1343.5	0.000
24	0.068	0.016	1348.2	0.000
25	-0.050	0.046	1350.8	0.000
26	0.010	-0.058	1350.8	0.000
27	0.004	-0.012	1350.9	0.000
28	-0.018	-0.012	1351.2	0.000
29	0.035	0.020	1352.5	0.000
30	-0.047	-0.021	1354.7	0.000
31	0.050	0.005	1357.3	0.000
32	-0.059	-0.025	1361.0	0.000
33	0.061	0.004	1364.8	0.000
34	-0.077	-0.042	1371.0	0.000
35	0.091	0.014	1379.5	0.000
36	-0.089	0.006	1387.8	0.000



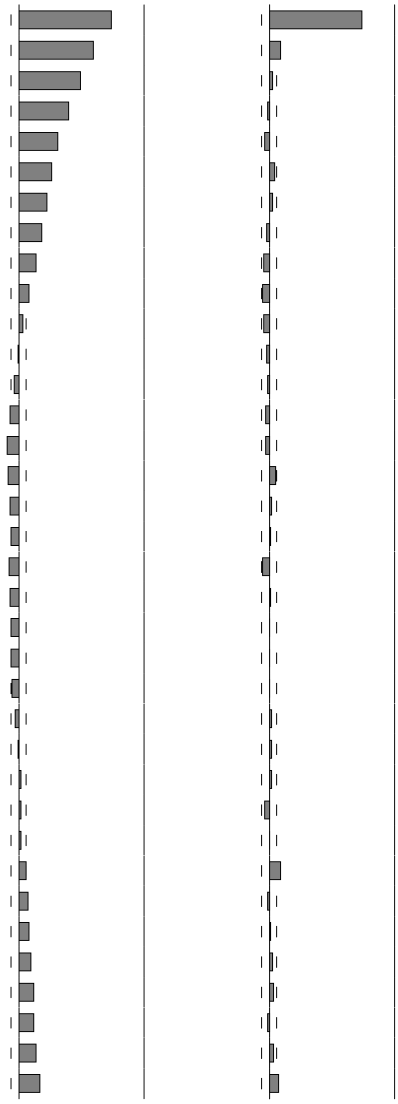
Theoretisches Korrelogramm eines AR(1) mit a1=-0.75
1.2
0.8
0.4
0.0
-0.4
-0.8
1
2
3
4
5
6
7
8
9
10
rho
Auch hier flasche Abszissenbeschriftung!



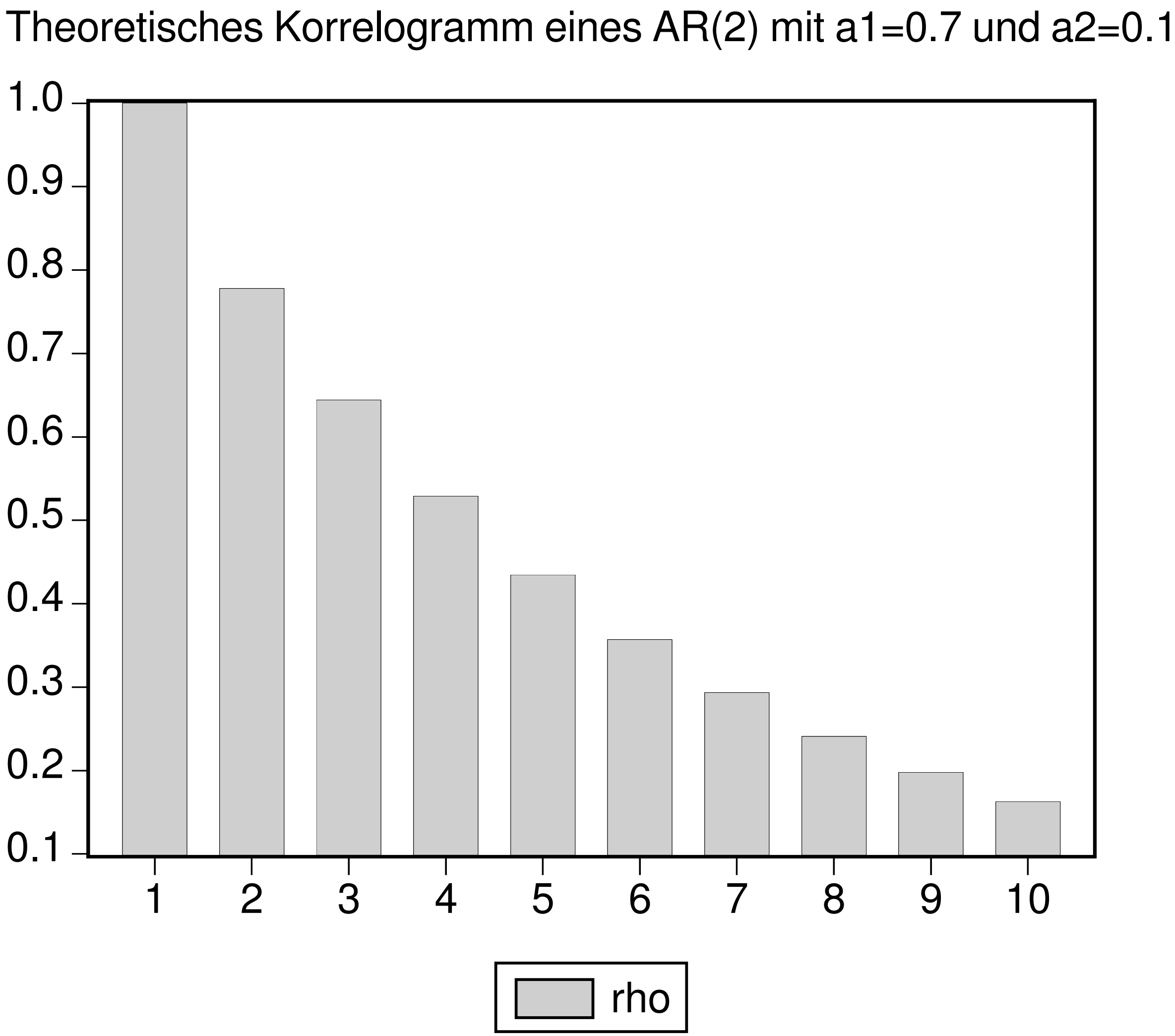
Zeitreihe eines AR(2) mit a1=0.7 und a2=0.1
6
4
2
0
-2
-4
-6
250
500
750
1000
AR(2)

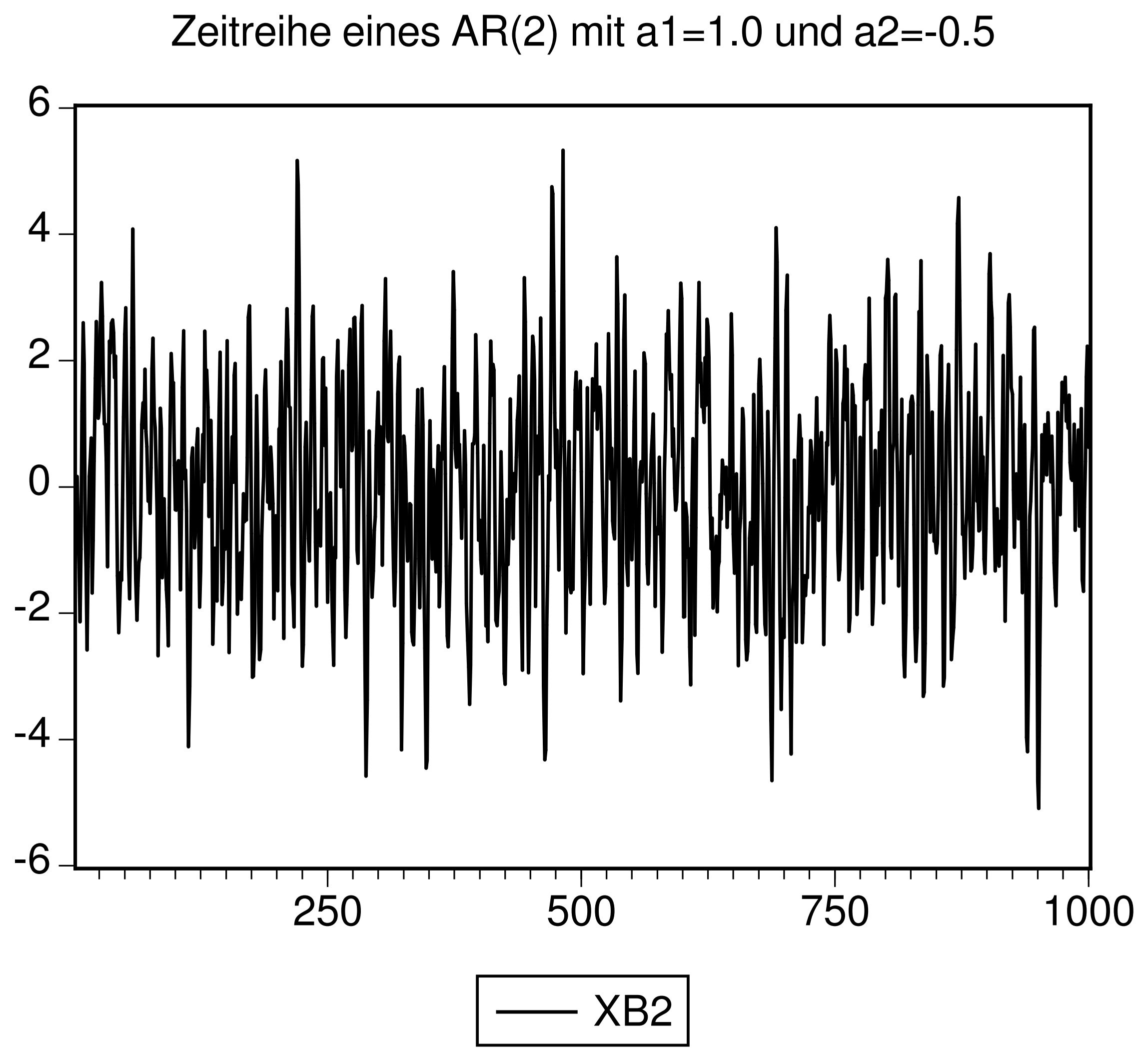
Korrelogramm eines AR(2) mit a1=0.7 und a2=0.1

Date: 08/05/07 Time: 11:26
Sample: 3 1000
Included observations: 998



Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.763	0.763	582.61	0.000
		2	0.621	0.093	969.15	0.000
		3	0.512	0.027	1232.1	0.000
		4	0.416	-0.011	1405.5	0.000
		5	0.325	-0.033	1511.3	0.000
		6	0.274	0.041	1586.7	0.000
		7	0.237	0.026	1643.2	0.000
		8	0.194	-0.019	1681.0	0.000
		9	0.143	-0.041	1701.8	0.000
		10	0.089	-0.052	1709.9	0.000
		11	0.036	-0.046	1711.2	0.000
		12	-0.006	-0.018	1711.2	0.000
		13	-0.036	-0.012	1712.5	0.000
		14	-0.066	-0.031	1716.9	0.000
		15	-0.092	-0.032	1725.5	0.000
		16	-0.082	0.050	1732.3	0.000
		17	-0.071	0.023	1737.4	0.000
		18	-0.061	0.012	1741.1	0.000
		19	-0.074	-0.053	1746.8	0.000
		20	-0.067	0.016	1751.4	0.000
		21	-0.062	0.004	1755.3	0.000
		22	-0.059	0.002	1758.9	0.000
		23	-0.052	0.003	1761.6	0.000
		24	-0.031	0.023	1762.6	0.000
		25	-0.007	0.024	1762.6	0.000
		26	0.018	0.025	1762.9	0.000
		27	0.016	-0.037	1763.2	0.000
		28	0.020	0.002	1763.6	0.000
		29	0.062	0.097	1767.6	0.000
		30	0.074	-0.009	1773.2	0.000
		31	0.085	0.015	1780.6	0.000
		32	0.103	0.028	1791.5	0.000
		33	0.127	0.039	1808.2	0.000
		34	0.129	-0.010	1825.4	0.000
		35	0.143	0.041	1846.4	0.000
		36	0.176	0.079	1878.5	0.000


Theoretisches Korrelogramm eines AR(2) mit a1=0.7 und a2=0.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
1
2
3
4
5
6
7
8
9
10
rho

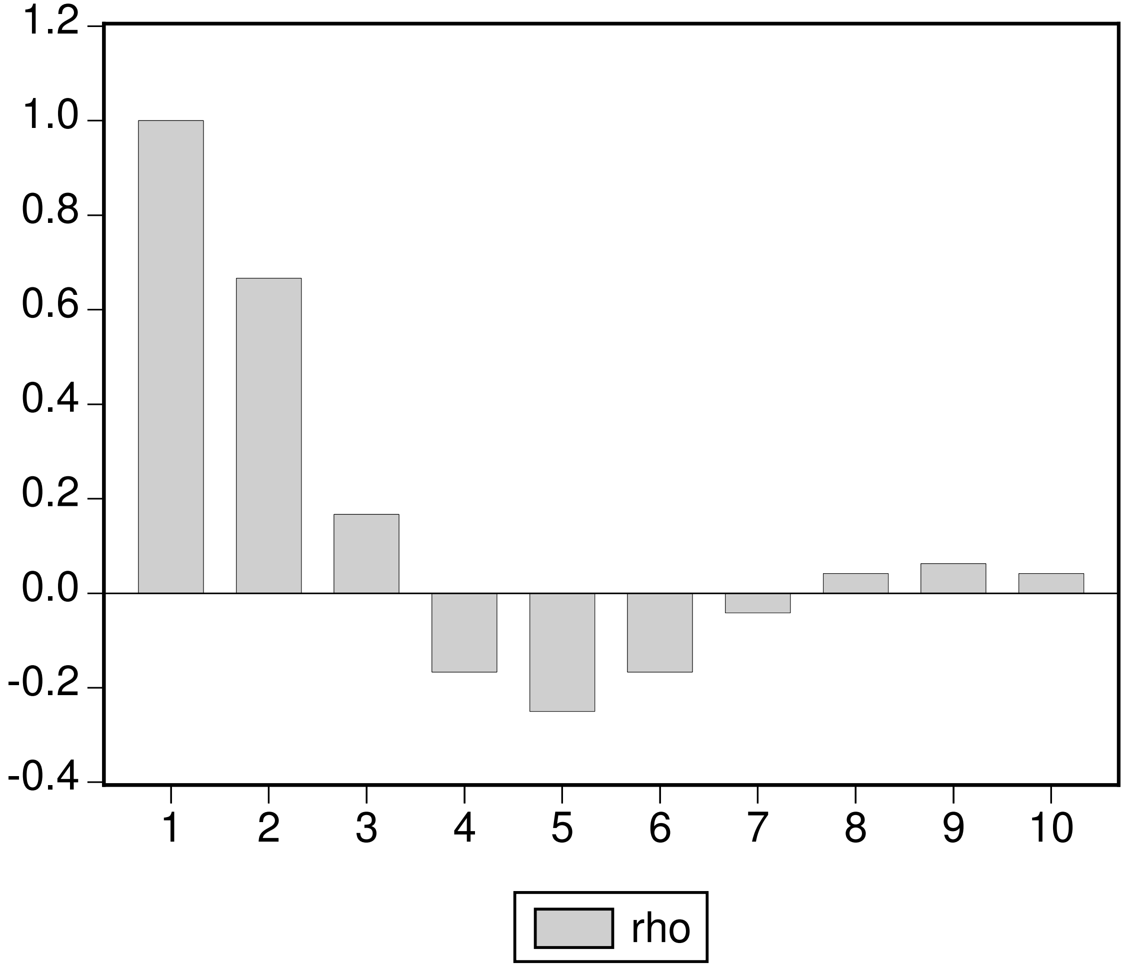

Zeitreihe eines AR(2) mit a1=1.0 und a2=-0.5
6
4
2
0
-2
-4
-6
250
500
750
1000
XB2

Korrelogramm eines AR(2) mit a1=1.0 und a2=-0.5

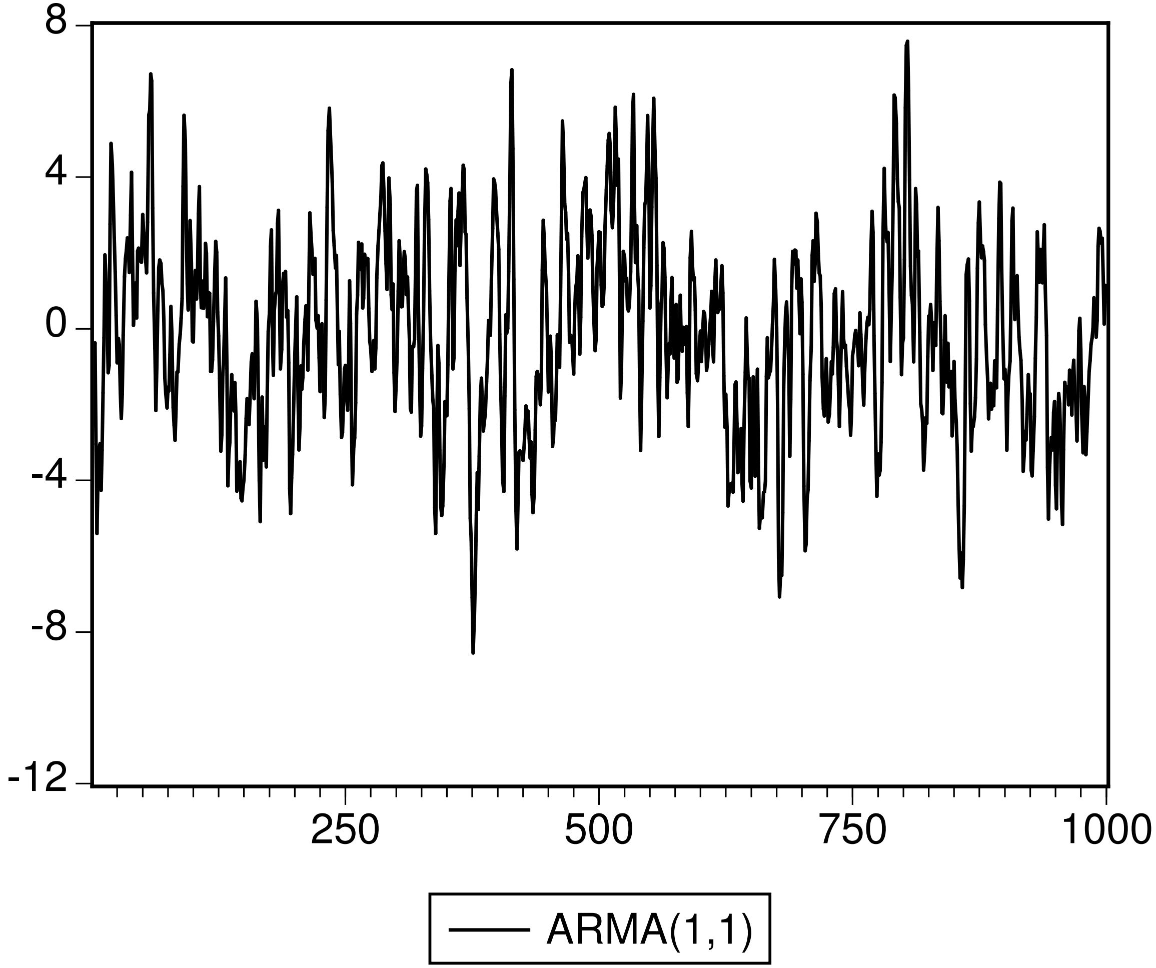
Date: 08/05/07 Time: 11:32
Sample: 3 1000
Included observations: 998

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.687	0.687	472.69	0.000
		2	0.204	-0.509	514.19	0.000
		3	-0.142	-0.007	534.29	0.000
		4	-0.258	-0.012	601.04	0.000
		5	-0.213	-0.028	646.45	0.000
		6	-0.097	0.016	655.87	0.000
		7	0.007	-0.005	655.92	0.000
		8	0.049	-0.027	658.32	0.000
		9	0.048	0.023	660.68	0.000
		10	0.033	0.005	661.80	0.000
		11	0.012	-0.014	661.94	0.000
		12	-0.012	-0.014	662.09	0.000
		13	-0.034	-0.018	663.27	0.000
		14	-0.040	0.002	664.93	0.000
		15	-0.025	0.009	665.59	0.000
		16	0.006	0.017	665.62	0.000
		17	0.019	-0.032	666.00	0.000
		18	0.019	0.019	666.38	0.000
		19	0.014	0.003	666.58	0.000
		20	-0.001	-0.022	666.58	0.000
		21	-0.001	0.039	666.58	0.000
		22	0.021	0.029	667.04	0.000
		23	0.029	-0.033	667.92	0.000
		24	0.035	0.056	669.20	0.000
		25	0.028	-0.019	670.00	0.000
		26	0.017	0.017	670.32	0.000
		27	0.005	0.002	670.34	0.000
		28	-0.008	-0.011	670.41	0.000
		29	0.003	0.052	670.42	0.000
		30	0.032	0.025	671.46	0.000
		31	0.059	0.021	675.04	0.000
		32	0.063	0.007	679.09	0.000
		33	0.025	-0.038	679.73	0.000
		34	-0.010	0.042	679.83	0.000
		35	-0.029	-0.014	680.68	0.000
		36	-0.024	0.014	681.28	0.000

Theoretisches Korrelogramm eines AR(2) mit a1=1.0 und a2=-0.5



Zeitreihe eines ARMA(1,1) mit a=0.75 und b=0.75

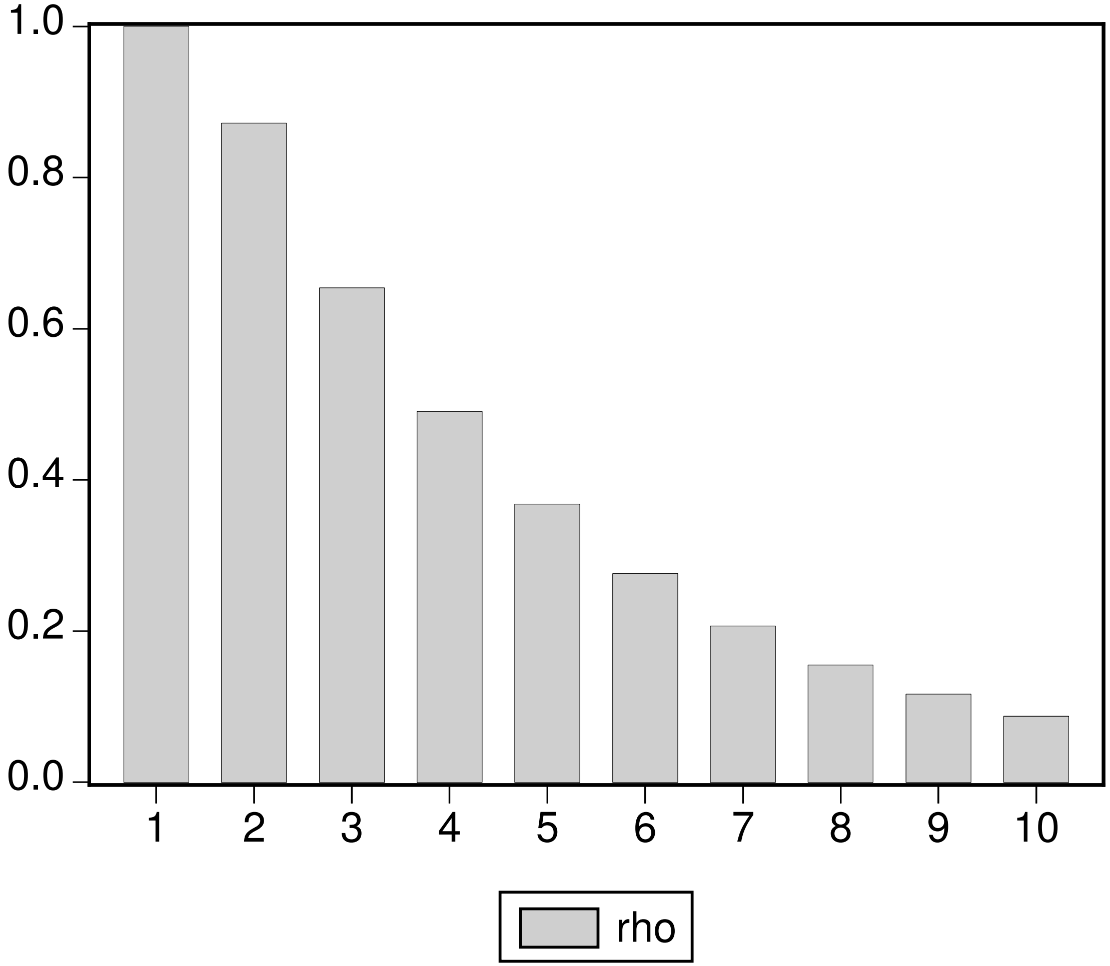


Korrelogramm eines ARMA(1,1) mit a=0.75 und b=0.75

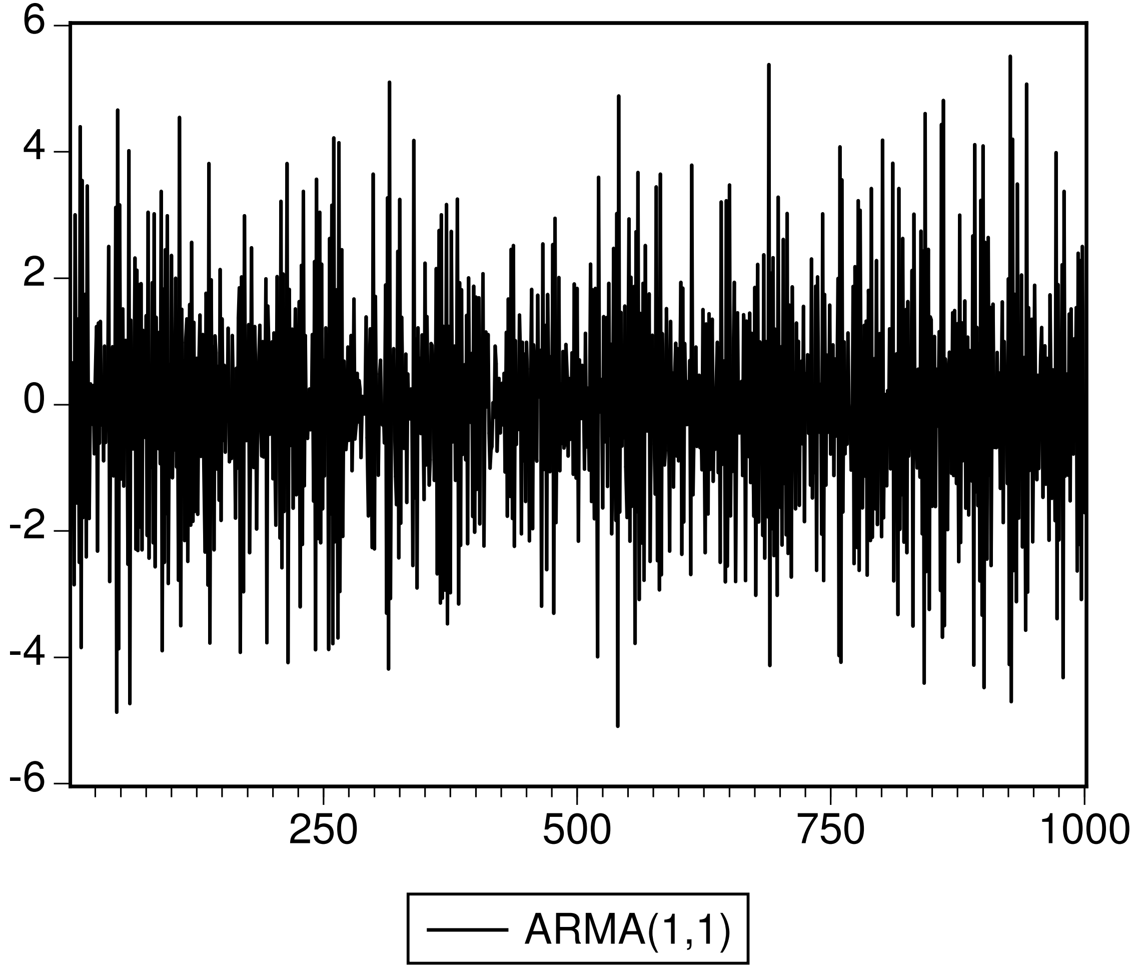
Date: 08/05/07 Time: 11:37
Sample: 2 1000
Included observations: 999

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.882	0.882	779.33	0.000
		2	0.673	-0.470	1234.0	0.000
		3	0.499	0.234	1483.8	0.000
		4	0.357	-0.183	1612.0	0.000
		5	0.258	0.174	1679.0	0.000
		6	0.197	-0.084	1718.2	0.000
		7	0.166	0.125	1745.9	0.000
		8	0.151	-0.065	1769.0	0.000
		9	0.142	0.070	1789.5	0.000
		10	0.132	-0.053	1807.1	0.000
		11	0.116	0.025	1820.7	0.000
		12	0.097	-0.013	1830.3	0.000
		13	0.086	0.051	1837.9	0.000
		14	0.081	-0.020	1844.6	0.000
		15	0.084	0.064	1851.7	0.000
		16	0.096	0.009	1861.0	0.000
		17	0.111	0.033	1873.5	0.000
		18	0.122	-0.007	1888.7	0.000
		19	0.128	0.033	1905.5	0.000
		20	0.131	0.001	1922.9	0.000
		21	0.123	-0.022	1938.3	0.000
		22	0.109	0.031	1950.6	0.000
		23	0.102	0.017	1961.3	0.000
		24	0.101	0.013	1971.7	0.000
		25	0.099	-0.008	1981.7	0.000
		26	0.093	-0.002	1990.6	0.000
		27	0.086	-0.001	1998.1	0.000
		28	0.087	0.074	2005.9	0.000
		29	0.098	-0.010	2015.8	0.000
		30	0.109	0.038	2028.0	0.000
		31	0.121	0.014	2043.1	0.000
		32	0.117	-0.078	2057.3	0.000
		33	0.094	0.004	2066.4	0.000
		34	0.074	0.038	2072.1	0.000
		35	0.058	-0.053	2075.6	0.000
		36	0.044	0.048	2077.5	0.000

Theoretisches Korrelogramm eines ARMA(1,1) mit a=0.75 und b=0.75

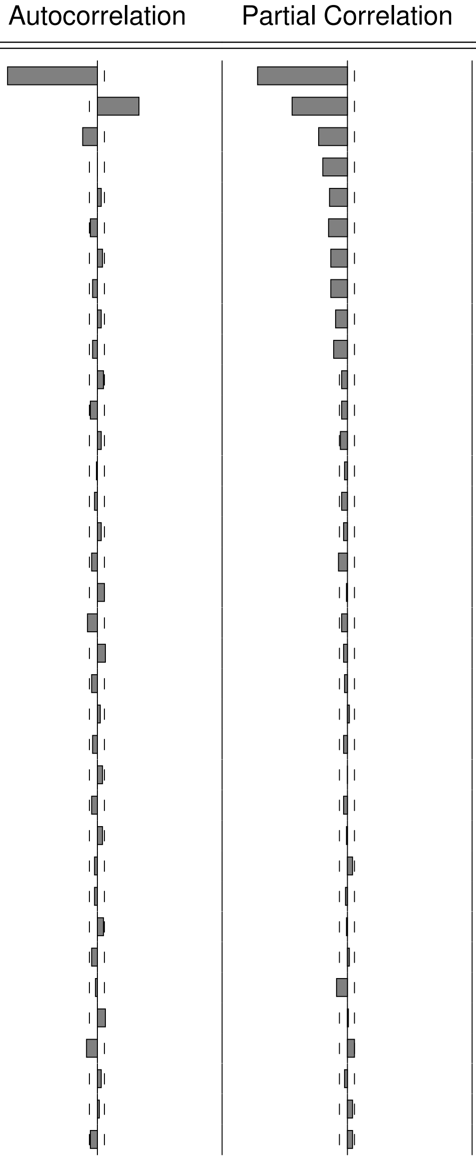


Zeitreihe eines ARMA(1,1) mit a=-0.5 und b=-0.9



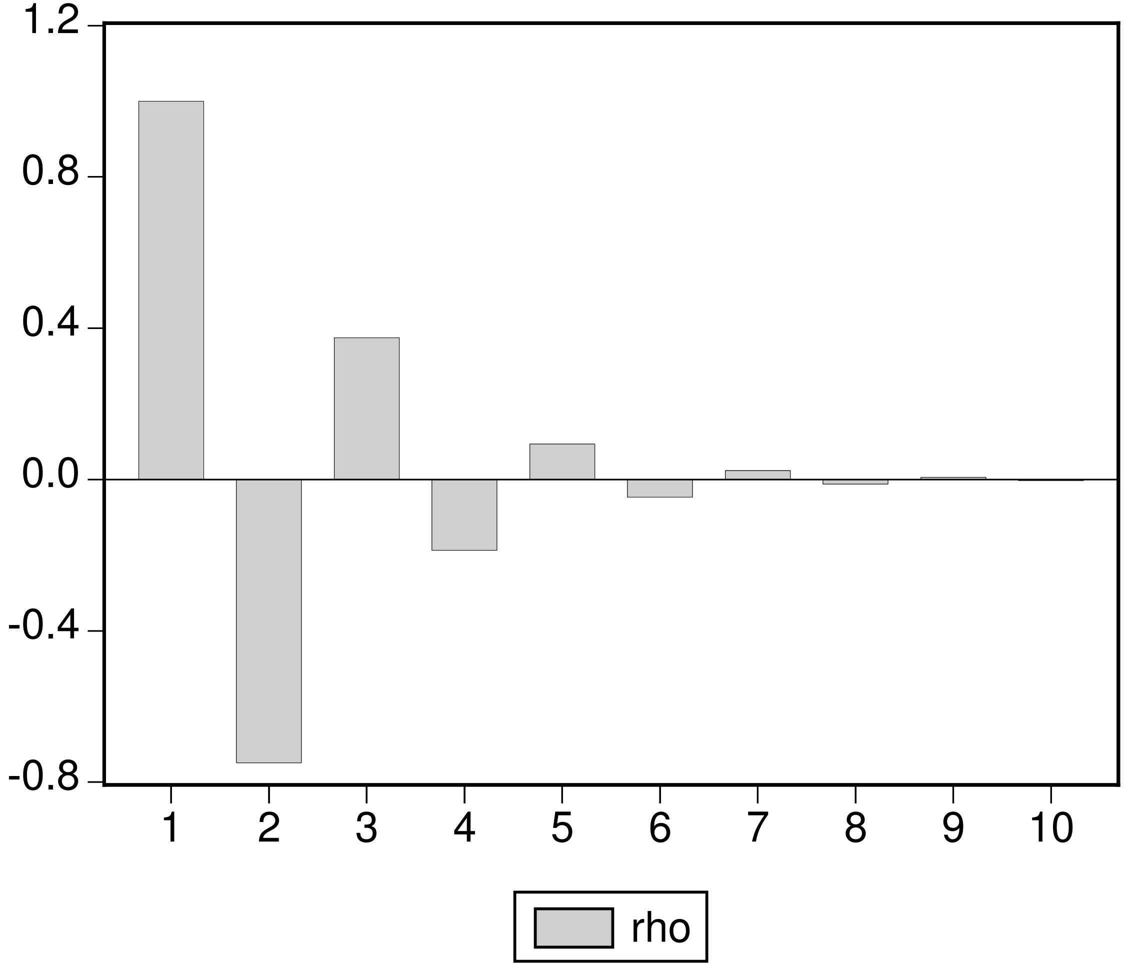
Korrelogramm eines AR(1,1) mit a=-0.5 und b=-0.9

Date: 08/05/07 Time: 11:42
Sample: 2 1000
Included observations: 999



	AC	PAC	Q-Stat	Prob
1	-0.741	-0.741	550.66	0.000
2	0.346	-0.453	670.55	0.000
3	-0.120	-0.233	685.04	0.000
4	0.002	-0.205	685.04	0.000
5	0.041	-0.142	686.71	0.000
6	-0.055	-0.151	689.81	0.000
7	0.048	-0.132	692.16	0.000
8	-0.037	-0.135	693.55	0.000
9	0.034	-0.094	694.71	0.000
10	-0.037	-0.113	696.06	0.000
11	0.050	-0.045	698.61	0.000
12	-0.053	-0.045	701.50	0.000
13	0.035	-0.057	702.73	0.000
14	-0.006	-0.024	702.77	0.000
15	-0.020	-0.046	703.20	0.000
16	0.034	-0.030	704.38	0.000
17	-0.046	-0.070	706.52	0.000
18	0.064	-0.006	710.71	0.000
19	-0.076	-0.044	716.53	0.000
20	0.069	-0.033	721.35	0.000
21	-0.044	-0.018	723.34	0.000
22	0.031	0.023	724.29	0.000
23	-0.038	-0.026	725.75	0.000
24	0.045	0.002	727.81	0.000
25	-0.048	-0.030	730.15	0.000
26	0.046	-0.002	732.33	0.000
27	-0.020	0.047	732.76	0.000
28	-0.024	-0.013	733.34	0.000
29	0.049	-0.008	735.85	0.000
30	-0.041	0.024	737.59	0.000
31	-0.009	-0.088	737.67	0.000
32	0.073	0.013	743.19	0.000
33	-0.083	0.059	750.25	0.000
34	0.035	-0.018	751.49	0.000
35	0.024	0.042	752.09	0.000
36	-0.052	0.042	754.92	0.000

Theoretisches Korrelogramm eines ARMA(1,1) mit a=-0.5 und b=-0.9



Goethe-Universität Frankfurt
Statistik und Methoden der Ökonometrie
Prof. Dr. Uwe Hassler
Finanzökonometrie Sommersemester 2007

4. Übung: Zinsstrukturanalyse

Laden Sie die EViews-Datei *geldzins* (zugänglich unter "Lehrmaterial"). Sie enthält monatliche Beobachtungen des deutschen Interbanken-Zinses für 1-, 3-, 6- und 12-Monatsgeld von der Wiedervereinigung bis zur Einführung der Europäischen Zentralbank, 1990.07 bis 1998.12. Wir sind an der Wirkung des Zinses für 1-Monatsgeld auf 3-Monatsgeld interessiert.

a) Betrachten Sie die Zeitreihen und ihre Differenzen. Passen Sie den Differenzen speziell von $r3$ und $r1$ AR-Prozesse an. Tun Sie dies auch für den Zinsabstand (spread) $r3 - r1$.

b) Regressieren Sie

$$\Delta r3_t = a + c_0 \, \Delta r1_t + \varepsilon_t \, .$$

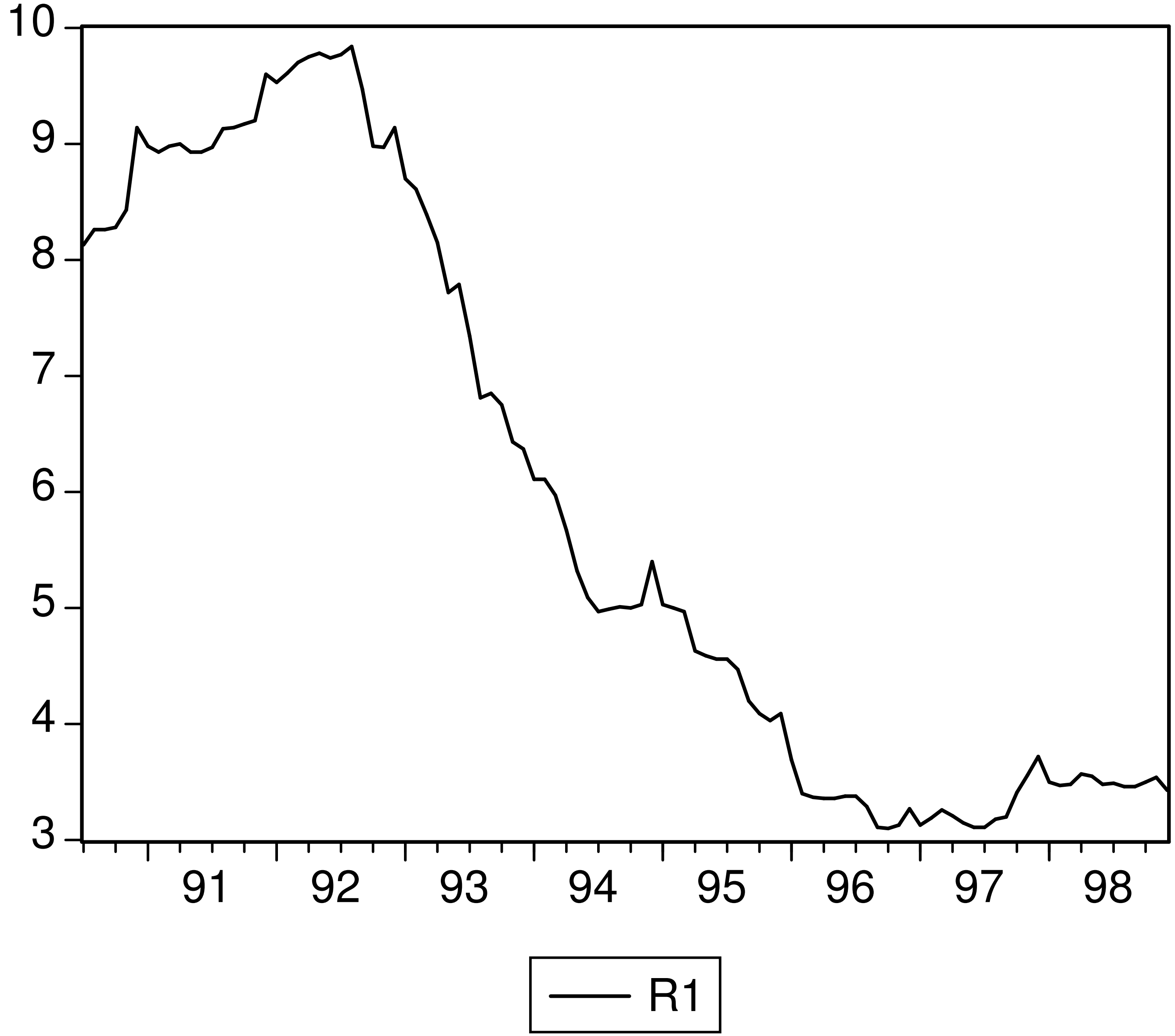
Was können Sie über die Residuen sagen?

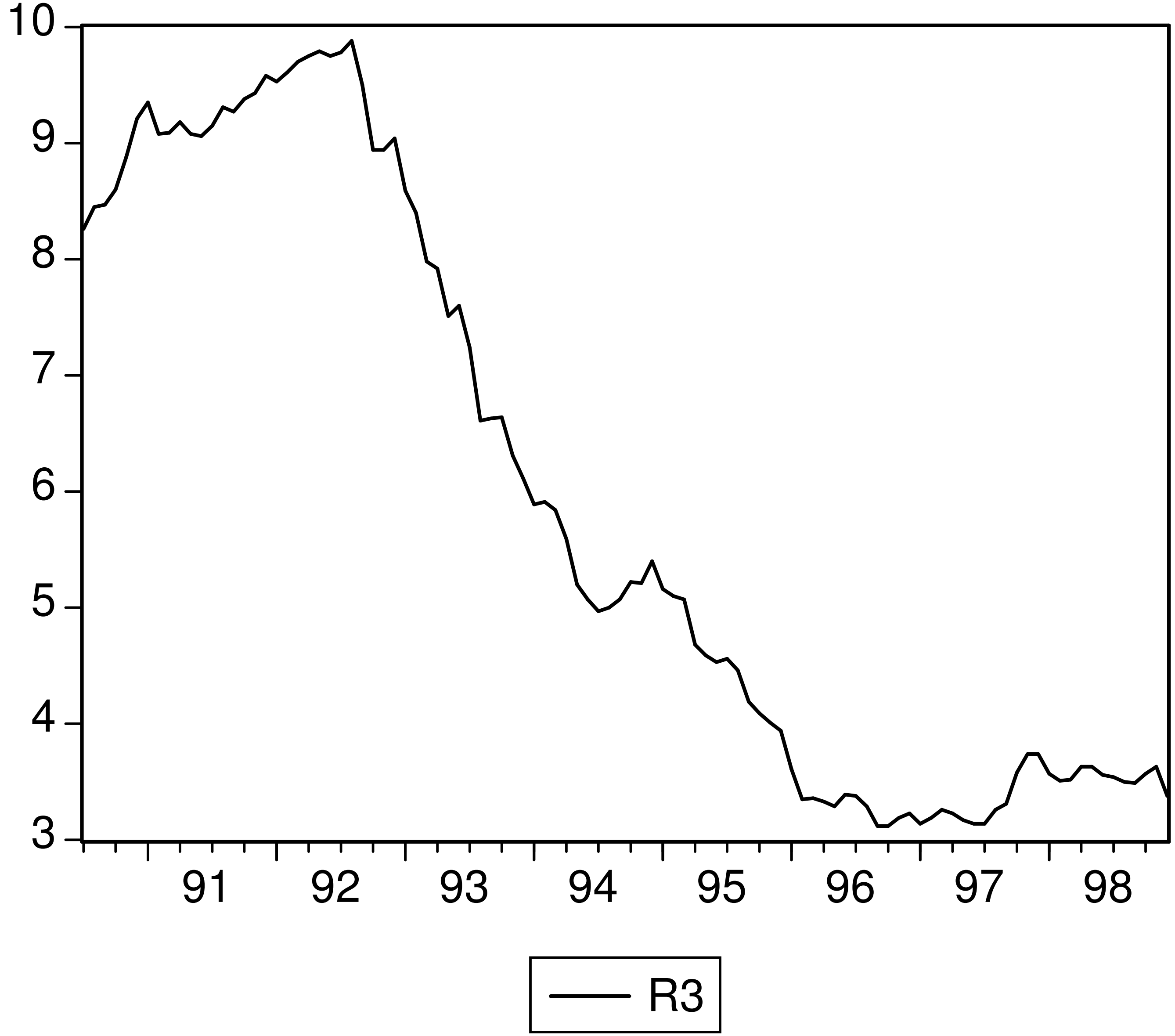
c) Schätzen Sie nun

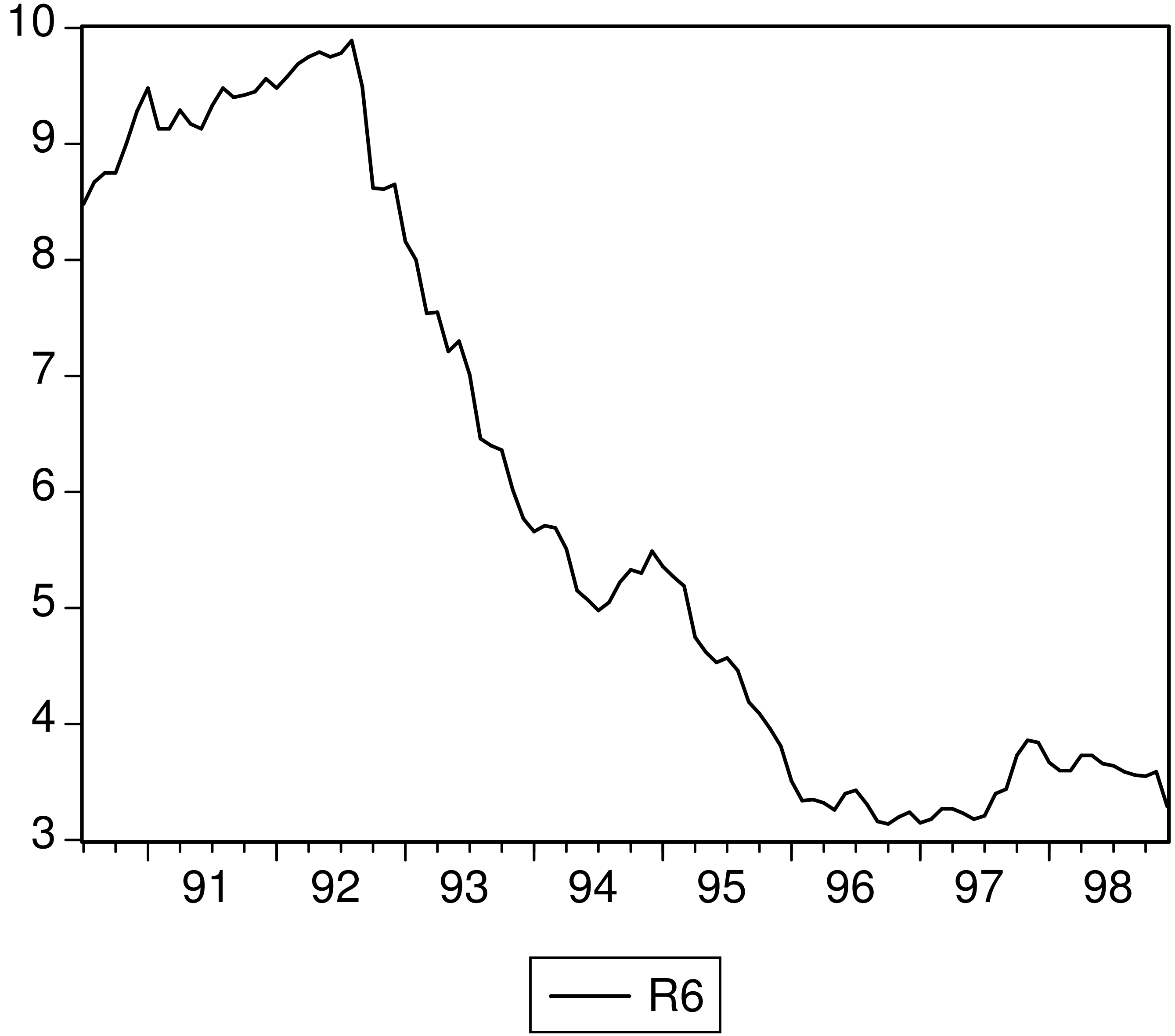
$$\Delta r3_t = a + c_0 \, \Delta r1_t + c_1 \, \Delta r1_{t-1} + a_1 \, \Delta r3_{t-1} + \varepsilon_t \, .$$

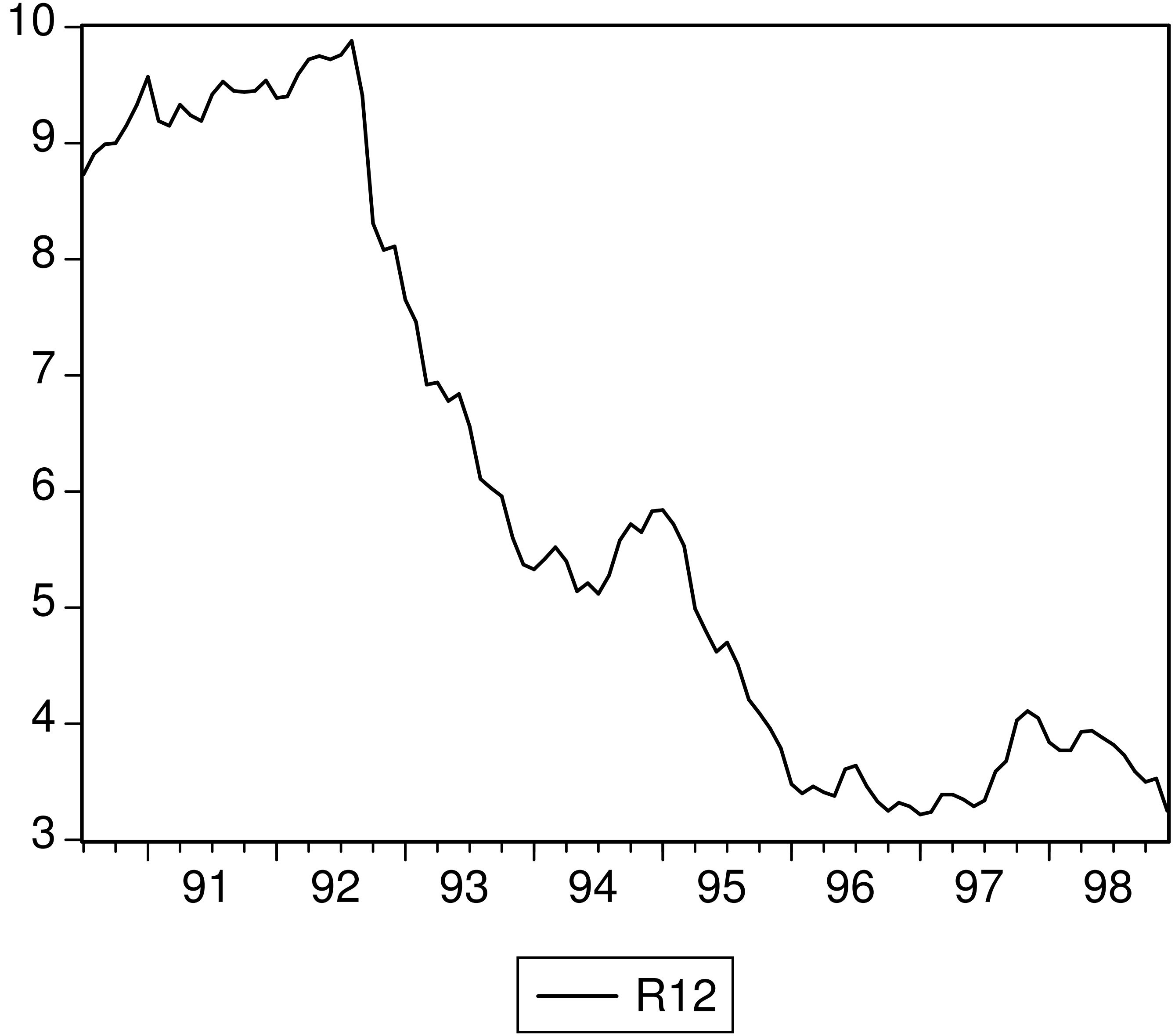
Tun Sie dies unrestringiert, und unter den Restriktionen
(i) $a_1 = 0$
(ii) $c_1 = 0$
(iii) $c_0 = 0$
Für welches Modell entscheiden Sie sich? Aufgrund welcher Kriterien?

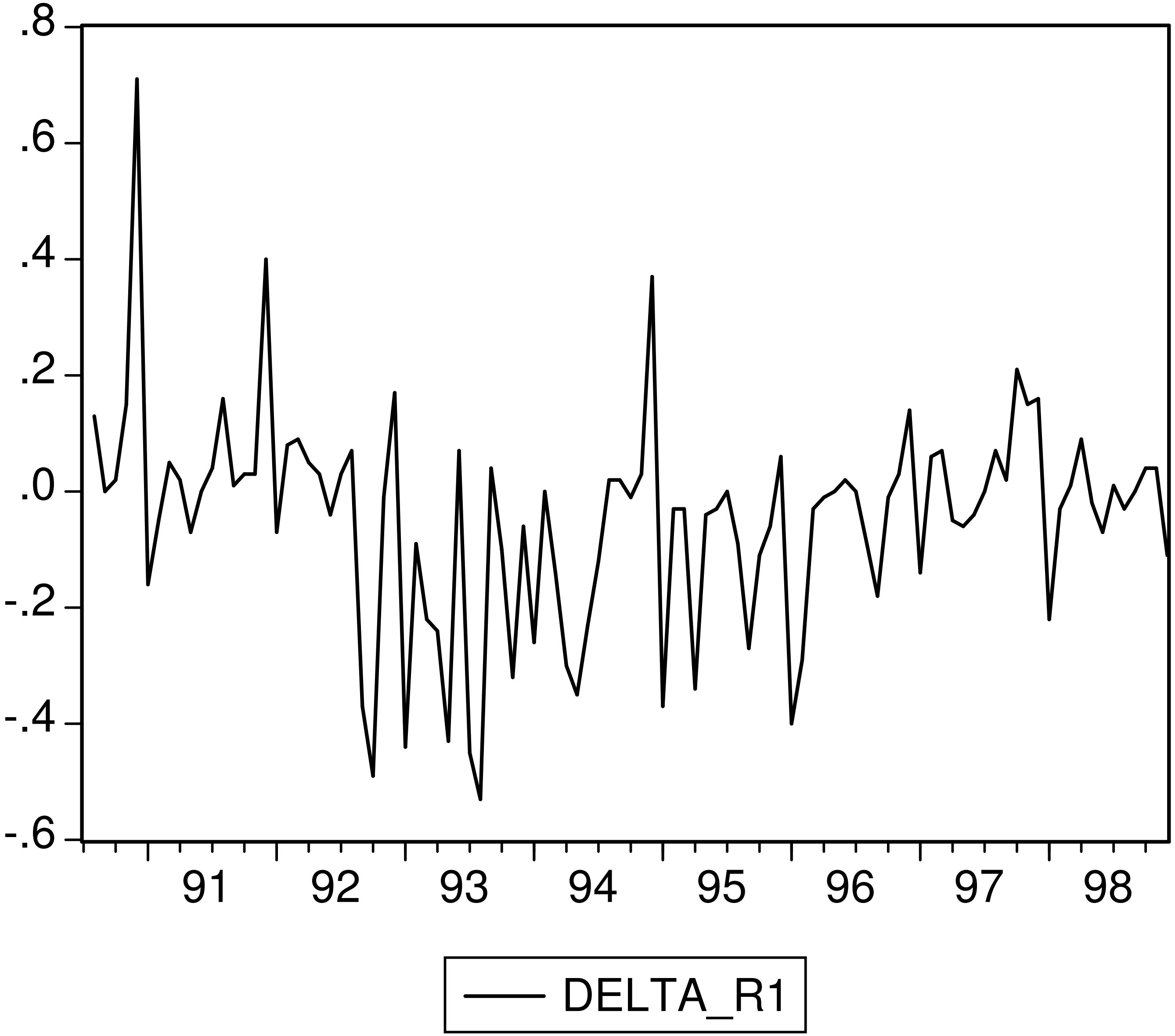
d) Erfüllen die Gleichungen aus c) die Stabilitätsbedingung? Berechnen Sie jeweils den langfristigen Zusammenhang (Langfristmultiplikator).


10
9
8
7
6
5
4
3
91
92
93
94
95
96
97
98
R1

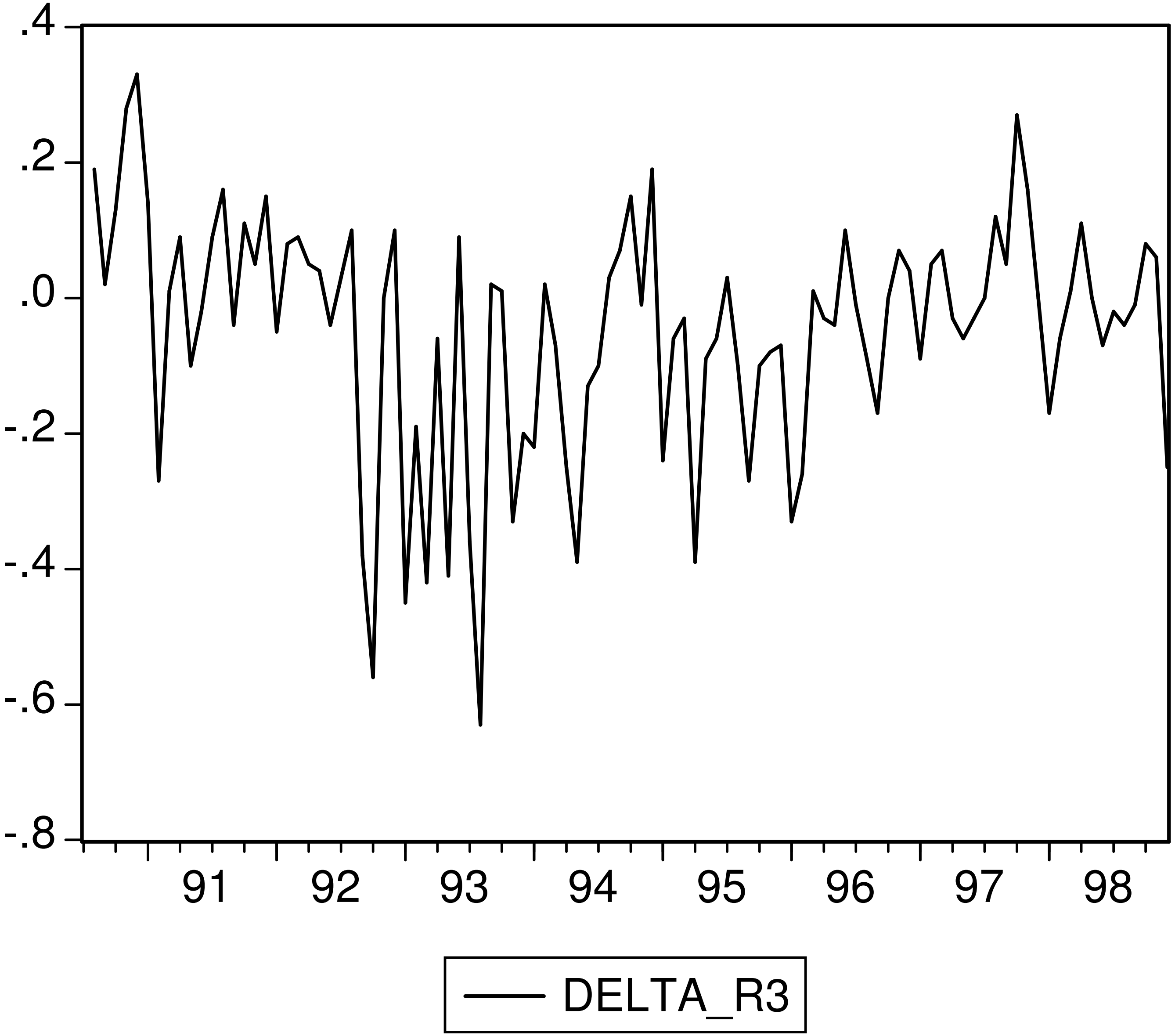

10
9
8
7
6
5
4
3
91
92
93
94
95
96
97
98
R3

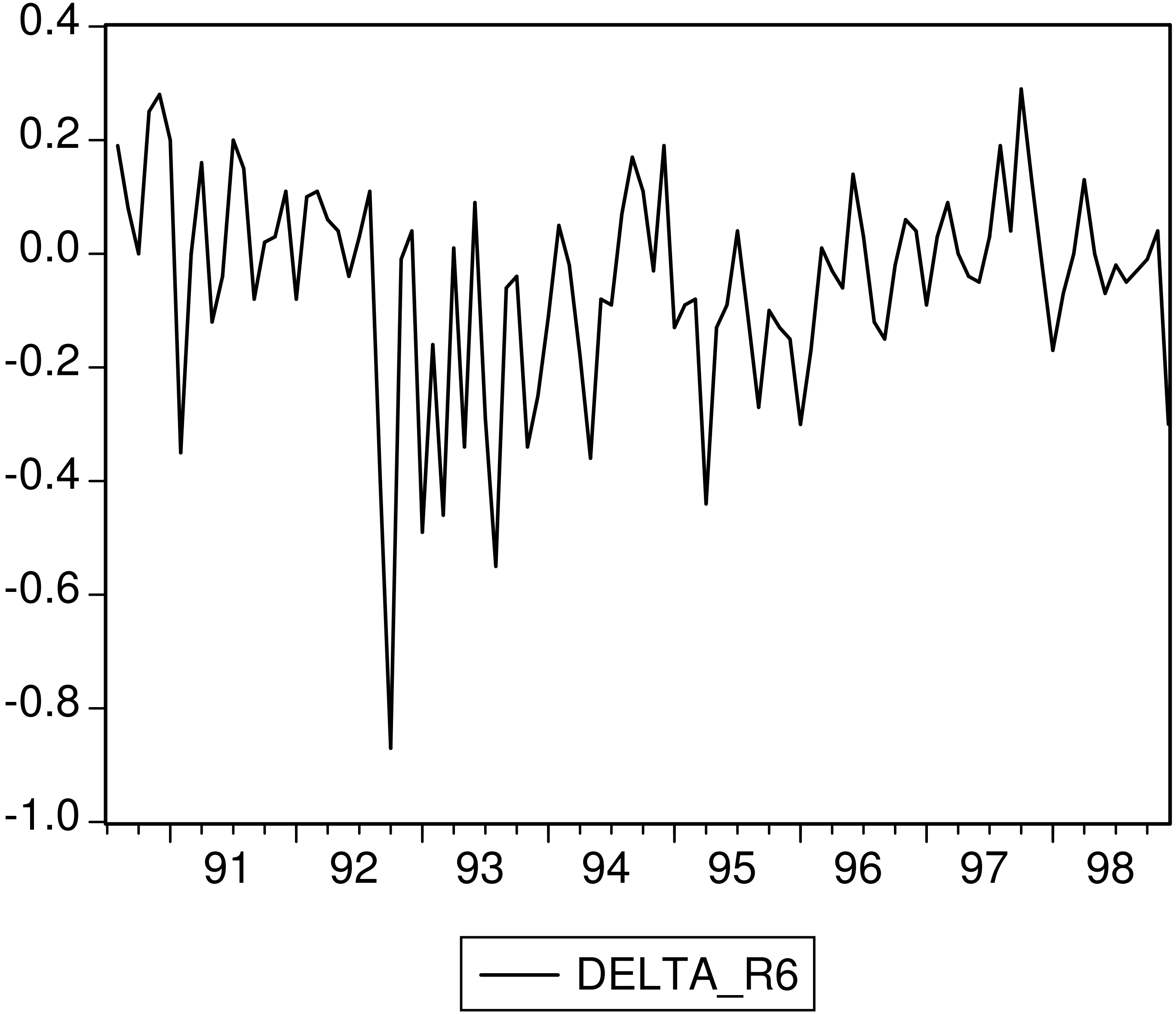

10
9
8
7
6
5
4
3
91
92
93
94
95
96
97
98
R6

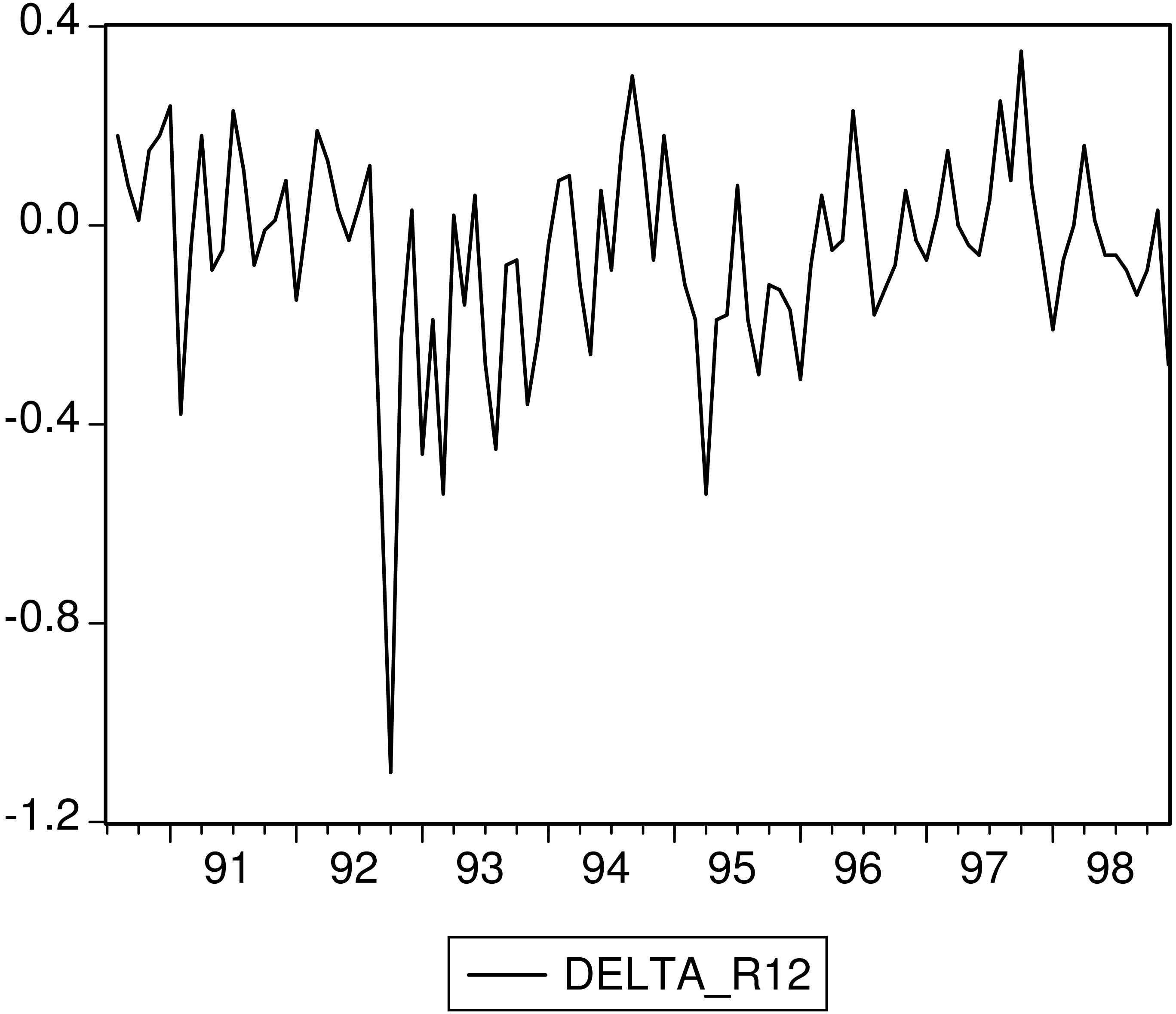

10
9
8
7
6
5
4
3
91
92
93
94
95
96
97
98
R12



.8
.6
.4
.2
.0
-.2
-.4
-.6
91
92
93
94
95
96
97
98
DELTA_R1


.4
.2
.0
-.2
-.4
-.6
-.8
91
92
93
94
95
96
97
98
DELTA_R3


0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
91
92
93
94
95
96
97
98
DELTA_R6



0.4
0.0
-0.4
-0.8
-1.2
91
92
93
94
95
96
97
98
DELTA_R12

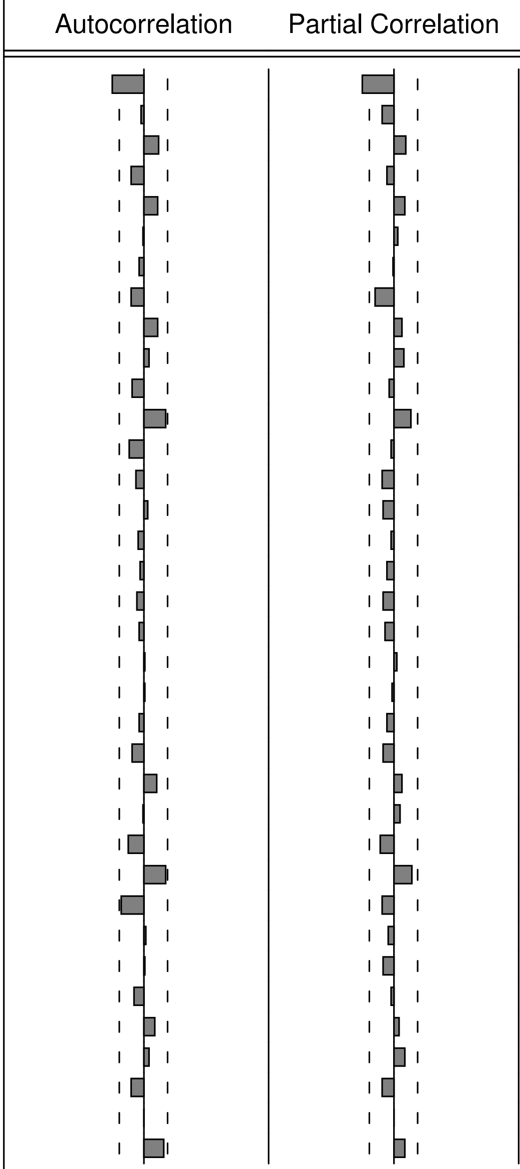
Dependent Variable: DELTA_R3
Method: Least Squares
Date: 05/17/07 Time: 10:31
Sample(adjusted): 1990:08 1998:12
Included observations: 101 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.009036	0.008468	-1.067059	0.2885
DELTA_R1	0.844123	0.044330	19.04175	0.0000

R-squared	0.785523	Mean dependent var	-0.048317
Adjusted R-squared	0.783357	S.D. dependent var	0.177331
S.E. of regression	0.082538	Akaike info criterion	-2.131502
Sum squared resid	0.674447	Schwarz criterion	-2.079717
Log likelihood	109.6408	F-statistic	362.5881
Durbin-Watson stat	2.473286	Prob(F-statistic)	0.000000

Correlogram of Residuals

Date: 05/17/07 Time: 12:16
Sample: 1990:08 1998:12
Included observations: 101



	AC	PAC	Q-Stat	Prob
1	-0.259	-0.259	6.9686	0.008
2	-0.023	-0.096	7.0236	0.030
3	0.123	0.099	8.6318	0.035
4	-0.105	-0.051	9.8079	0.044
5	0.120	0.097	11.356	0.045
6	-0.001	0.039	11.357	0.078
7	-0.034	0.000	11.485	0.119
8	-0.106	-0.156	12.739	0.121
9	0.122	0.071	14.432	0.108
10	0.043	0.089	14.646	0.146
11	-0.096	-0.039	15.719	0.152
12	0.185	0.141	19.714	0.073
13	-0.118	-0.020	21.354	0.066
14	-0.058	-0.096	21.757	0.084
15	0.036	-0.085	21.917	0.110
16	-0.046	-0.022	22.172	0.138
17	-0.032	-0.051	22.297	0.174
18	-0.056	-0.083	22.692	0.203
19	-0.034	-0.066	22.837	0.245
20	0.011	0.032	22.852	0.296
21	0.016	-0.013	22.885	0.350
22	-0.036	-0.057	23.058	0.398
23	-0.095	-0.087	24.258	0.390
24	0.112	0.066	25.952	0.356
25	-0.002	0.052	25.953	0.410
26	-0.131	-0.111	28.320	0.343
27	0.183	0.148	33.037	0.196
28	-0.189	-0.097	38.101	0.097
29	0.022	-0.048	38.168	0.119
30	0.009	-0.084	38.181	0.145
31	-0.074	-0.023	38.991	0.153
32	0.093	0.047	40.298	0.149
33	0.045	0.098	40.607	0.170
34	-0.103	-0.095	42.268	0.156
35	0.005	0.000	42.273	0.186
36	0.167	0.094	46.721	0.109

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	4.651926	Probability	0.011771
Obs*R-squared	8.839652	Probability	0.012036

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 05/17/07 Time: 12:33
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.002754	0.008237	0.334407	0.7388
DELTA_R1	0.045727	0.046150	0.990823	0.3242
RESID(-1)	-0.326463	0.107380	-3.040261	0.0030
RESID(-2)	-0.132329	0.107270	-1.233614	0.2203

R-squared	0.087521	Mean dependent var	-7.69E-18
Adjusted R-squared	0.059300	S.D. dependent var	0.082125
S.E. of regression	0.079653	Akaike info criterion	-2.183488
Sum squared resid	0.615419	Schwarz criterion	-2.079919
Log likelihood	114.2662	F-statistic	3.101284
Durbin-Watson stat	2.006547	Prob(F-statistic)	0.030243

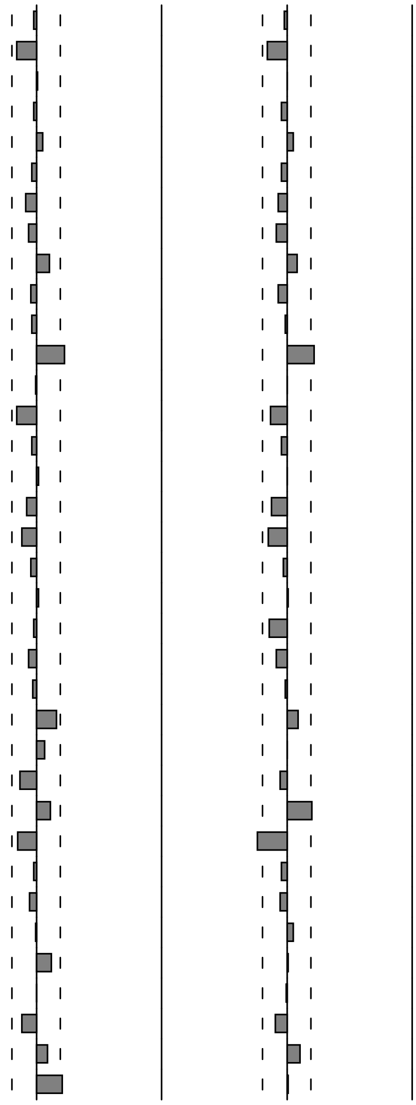
Dependent Variable: DELTA_R3
Method: Least Squares
Date: 05/17/07 Time: 12:00
Sample(adjusted): 1990:09 1998:12
Included observations: 100 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.006087	0.008063	-0.755008	0.4521
DELTA_R1	0.841931	0.043284	19.45132	0.0000
DELTA_R1(-1)	0.352649	0.090427	3.899810	0.0002
DELTA_R3(-1)	-0.264347	0.097562	-2.709514	0.0080

R-squared	0.817951	Mean dependent var	-0.050700
Adjusted R-squared	0.812262	S.D. dependent var	0.176591
S.E. of regression	0.076515	Akaike info criterion	-2.263489
Sum squared resid	0.562032	Schwarz criterion	-2.159283
Log likelihood	117.1745	F-statistic	143.7765
Durbin-Watson stat	2.004040	Prob(F-statistic)	0.000000

Correlogram of Residuals

Date: 05/17/07 Time: 12:11
Sample: 1990:09 1998:12
Included observations: 100



Autocorrelation / Partial Correlation	AC	PAC	Q-Stat	Prob
1	-0.023	-0.023	0.0533	0.817
2	-0.157	-0.158	2.6321	0.268
3	0.009	0.002	2.6412	0.450
4	-0.022	-0.047	2.6911	0.611
5	0.054	0.056	3.0050	0.699
6	-0.038	-0.048	3.1593	0.789
7	-0.082	-0.068	3.8968	0.792
8	-0.062	-0.085	4.3285	0.826
9	0.107	0.087	5.6015	0.779
10	-0.042	-0.069	5.8016	0.832
11	-0.041	-0.012	5.9915	0.874
12	0.236	0.226	12.445	0.411
13	-0.006	0.004	12.448	0.491
14	-0.164	-0.132	15.627	0.337
15	-0.033	-0.043	15.761	0.398
16	0.022	0.007	15.822	0.465
17	-0.077	-0.123	16.543	0.486
18	-0.123	-0.151	18.412	0.429
19	-0.049	-0.029	18.710	0.476
20	0.018	0.013	18.752	0.538
21	-0.024	-0.141	18.829	0.596
22	-0.061	-0.088	19.318	0.626
23	-0.032	-0.010	19.451	0.675
24	0.169	0.092	23.273	0.504
25	0.068	0.001	23.895	0.525
26	-0.135	-0.051	26.420	0.440
27	0.116	0.206	28.309	0.395
28	-0.152	-0.241	31.579	0.292
29	-0.024	-0.043	31.664	0.335
30	-0.054	-0.053	32.090	0.363
31	-0.005	0.050	32.093	0.412
32	0.125	0.014	34.430	0.352
33	0.001	-0.004	34.430	0.399
34	-0.121	-0.094	36.691	0.345
35	0.092	0.113	38.014	0.334
36	0.218	0.012	45.564	0.132

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.658059	Probability	0.196031
Obs*R-squared	3.407574	Probability	0.181993

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 05/17/07 Time: 12:31
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000285	0.008345	0.034145	0.9728
DELTA_R1	0.010884	0.044003	0.247354	0.8052
DELTA_R1(-1)	0.185630	0.256519	0.723648	0.4711
DELTA_R3(-1)	-0.189883	0.287858	-0.659640	0.5111
RESID(-1)	0.155606	0.307319	0.506334	0.6138
RESID(-2)	-0.238963	0.137981	-1.731849	0.0866

R-squared	0.034076	Mean dependent var	-1.58E-17
Adjusted R-squared	-0.017303	S.D. dependent var	0.075346
S.E. of regression	0.075996	Akaike info criterion	-2.258159
Sum squared resid	0.542880	Schwarz criterion	-2.101849
Log likelihood	118.9080	F-statistic	0.663224
Durbin-Watson stat	1.957383	Prob(F-statistic)	0.652234

Dependent Variable: DELTA_R3
Method: Least Squares
Date: 05/17/07 Time: 12:07
Sample(adjusted): 1990:09 1998:12
Included observations: 100 after adjusting endpoints

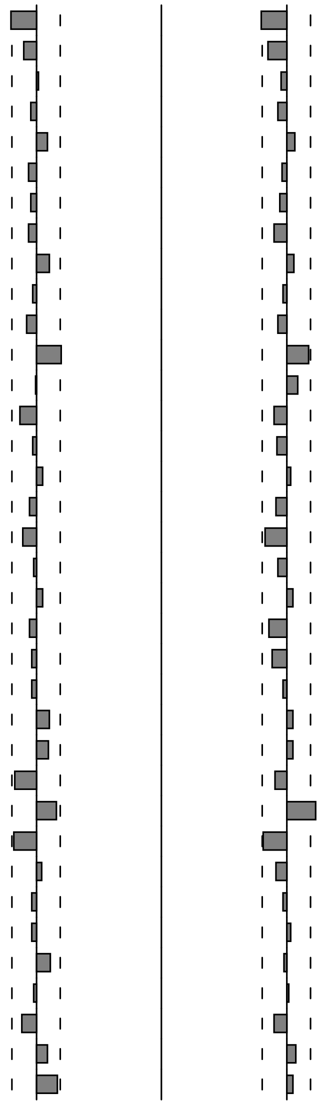
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.005169	0.008315	-0.621681	0.5356
DELTA_R1	0.813925	0.043384	18.76098	0.0000
DELTA_R1(-1)	0.135475	0.043212	3.135134	0.0023

R-squared	0.804029	Mean dependent var	-0.050700
Adjusted R-squared	0.799988	S.D. dependent var	0.176591
S.E. of regression	0.078976	Akaike info criterion	-2.209799
Sum squared resid	0.605013	Schwarz criterion	-2.131644
Log likelihood	113.4899	F-statistic	198.9851
Durbin-Watson stat	2.383248	Prob(F-statistic)	0.000000

Correlogram of Residuals

Date: 05/17/07 Time: 12:07
Sample: 1990:09 1998:12
Included observations: 100

Autocorrelation | Partial Correlation



	AC	PAC	Q-Stat	Prob
1	-0.213	-0.213	4.6752	0.031
2	-0.102	-0.155	5.7621	0.056
3	0.019	-0.042	5.7982	0.122
4	-0.042	-0.068	5.9839	0.200
5	0.093	0.071	6.9214	0.227
6	-0.058	-0.033	7.2802	0.296
7	-0.046	-0.050	7.5133	0.377
8	-0.062	-0.106	7.9374	0.440
9	0.107	0.065	9.2174	0.417
10	-0.032	-0.025	9.3302	0.501
11	-0.075	-0.068	9.9705	0.533
12	0.205	0.182	14.854	0.250
13	-0.004	0.093	14.856	0.316
14	-0.133	-0.106	16.950	0.259
15	-0.025	-0.079	17.025	0.317
16	0.050	0.033	17.330	0.365
17	-0.057	-0.089	17.727	0.406
18	-0.107	-0.176	19.162	0.382
19	-0.021	-0.069	19.218	0.443
20	0.051	0.053	19.544	0.487
21	-0.055	-0.140	19.937	0.525
22	-0.034	-0.121	20.086	0.578
23	-0.034	-0.028	20.241	0.627
24	0.110	0.057	21.850	0.588
25	0.105	0.050	23.350	0.557
26	-0.177	-0.098	27.674	0.375
27	0.167	0.245	31.561	0.249
28	-0.184	-0.189	36.376	0.133
29	0.044	-0.082	36.651	0.155
30	-0.036	-0.029	36.843	0.182
31	-0.040	0.035	37.077	0.209
32	0.122	-0.024	39.300	0.175
33	-0.021	0.020	39.364	0.206
34	-0.118	-0.099	41.526	0.176
35	0.096	0.081	42.968	0.167
36	0.176	0.051	47.920	0.088

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	4.096280	Probability	0.019660
Obs*R-squared	7.939099	Probability	0.018882

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 05/17/07 Time: 12:36
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.002914	0.008136	0.358164	0.7210
DELTA_R1	0.036385	0.043941	0.828034	0.4097
DELTA_R1(-1)	0.009853	0.042820	0.230110	0.8185
RESID(-1)	-0.283011	0.107068	-2.643286	0.0096
RESID(-2)	-0.186946	0.107684	-1.736065	0.0858

R-squared	0.079391	Mean dependent var	-5.27E-18
Adjusted R-squared	0.040629	S.D. dependent var	0.078174
S.E. of regression	0.076570	Akaike info criterion	-2.252519
Sum squared resid	0.556980	Schwarz criterion	-2.122260
Log likelihood	117.6259	F-statistic	2.048140
Durbin-Watson stat	1.970285	Prob(F-statistic)	0.093797

Dependent Variable: DELTA_R3
Method: Least Squares
Date: 05/17/07 Time: 12:13
Sample(adjusted): 1990:09 1998:12
Included observations: 100 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.007696	0.008622	-0.892678	0.3742
DELTA_R1	0.820465	0.045970	17.84801	0.0000
DELTA_R3(-1)	0.072896	0.048364	1.507257	0.1350

R-squared	0.789110	Mean dependent var	-0.050700
Adjusted R-squared	0.784762	S.D. dependent var	0.176591
S.E. of regression	0.081927	Akaike info criterion	-2.136431
Sum squared resid	0.651070	Schwarz criterion	-2.058275
Log likelihood	109.8215	F-statistic	181.4777
Durbin-Watson stat	2.553115	Prob(F-statistic)	0.000000

Correlogram of Residuals

Date: 05/17/07 Time: 12:13
Sample: 1990:09 1998:12
Included observations: 100

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	-0.295	-0.295	8.9964	0.003
		2	-0.054	-0.155	9.3049	0.010
		3	0.067	0.003	9.7826	0.021
		4	-0.073	-0.064	10.345	0.035
		5	0.098	0.072	11.369	0.045
		6	-0.015	0.029	11.394	0.077
		7	-0.032	-0.008	11.507	0.118
		8	-0.100	-0.138	12.625	0.125
		9	0.120	0.054	14.243	0.114
		10	0.012	0.047	14.259	0.161
		11	-0.101	-0.067	15.436	0.163
		12	0.182	0.143	19.274	0.082
		13	-0.066	0.051	19.778	0.101
		14	-0.092	-0.094	20.774	0.108
		15	0.010	-0.098	20.786	0.144
		16	0.013	-0.004	20.806	0.186
		17	-0.039	-0.050	20.997	0.226
		18	-0.079	-0.139	21.777	0.242
		19	-0.023	-0.100	21.843	0.292
		20	0.031	0.038	21.969	0.342
		21	-0.022	-0.063	22.031	0.398
		22	-0.027	-0.101	22.127	0.452
		23	-0.069	-0.079	22.760	0.475
		24	0.092	0.049	23.884	0.468
		25	0.062	0.070	24.408	0.496
		26	-0.152	-0.109	27.603	0.378
		27	0.193	0.200	32.783	0.204
		28	-0.198	-0.119	38.359	0.092
		29	0.056	-0.058	38.818	0.105
		30	0.000	-0.054	38.818	0.130
		31	-0.051	0.008	39.200	0.148
		32	0.098	0.024	40.653	0.140
		33	0.018	0.066	40.702	0.168
		34	-0.117	-0.115	42.804	0.143
		35	0.046	0.026	43.134	0.163
		36	0.176	0.096	48.044	0.086

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	9.020555	Probability	0.000259
Obs*R-squared	15.95978	Probability	0.000342

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 05/17/07 Time: 12:37
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.007498	0.008185	0.915981	0.3620
DELTA_R1	0.040416	0.044094	0.916578	0.3617
DELTA_R3(-1)	0.096378	0.050249	1.918008	0.0581
RESID(-1)	-0.495520	0.117852	-4.204597	0.0001
RESID(-2)	-0.241988	0.107088	-2.259711	0.0261

R-squared	0.159598	Mean dependent var	-2.78E-18
Adjusted R-squared	0.124212	S.D. dependent var	0.081095
S.E. of regression	0.075892	Akaike info criterion	-2.270305
Sum squared resid	0.547161	Schwarz criterion	-2.140047
Log likelihood	118.5153	F-statistic	4.510278
Durbin-Watson stat	1.932595	Prob(F-statistic)	0.002222

Dependent Variable: DELTA_R3
Method: Least Squares
Date: 05/17/07 Time: 12:14
Sample(adjusted): 1990:09 1998:12
Included observations: 100 after adjusting endpoints

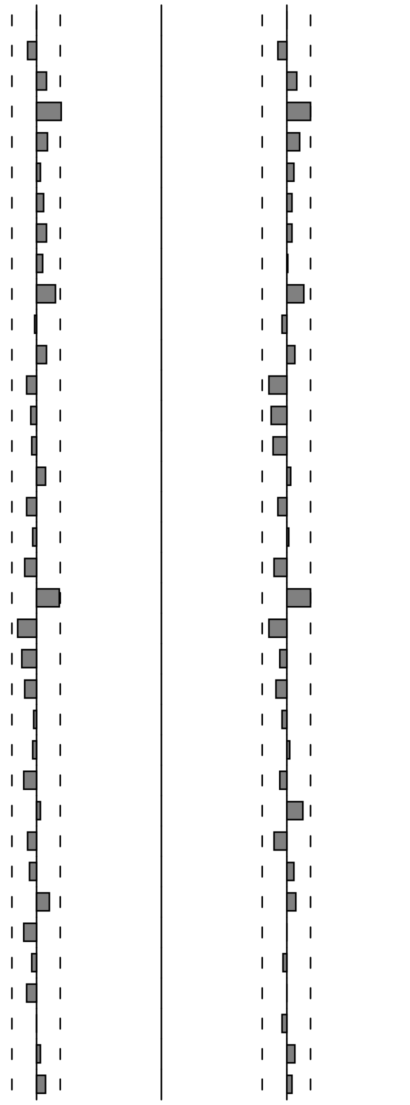
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.036038	0.017502	-2.059103	0.0422
DELTA_R1(-1)	0.128967	0.198346	0.650209	0.5171
DELTA_R3(-1)	0.188827	0.209507	0.901292	0.3697

R-squared	0.100460	Mean dependent var	-0.050700
Adjusted R-squared	0.081913	S.D. dependent var	0.176591
S.E. of regression	0.169204	Akaike info criterion	-0.685884
Sum squared resid	2.777106	Schwarz criterion	-0.607729
Log likelihood	37.29419	F-statistic	5.416446
Durbin-Watson stat	1.968584	Prob(F-statistic)	0.005888

Correlogram of Residuals

Date: 05/17/07 Time: 12:15
Sample: 1990:09 1998:12
Included observations: 100

Autocorrelation / Partial Correlation



	AC	PAC	Q-Stat	Prob
1	0.006	0.006	0.0039	0.950
2	-0.068	-0.068	0.4794	0.787
3	0.084	0.085	1.2169	0.749
4	0.208	0.205	5.8280	0.212
5	0.095	0.111	6.7981	0.236
6	0.038	0.064	6.9530	0.325
7	0.058	0.042	7.3219	0.396
8	0.089	0.042	8.2096	0.413
9	0.053	0.015	8.5301	0.482
10	0.158	0.141	11.364	0.330
11	-0.014	-0.041	11.386	0.412
12	0.087	0.072	12.266	0.425
13	-0.079	-0.146	13.006	0.447
14	-0.049	-0.124	13.293	0.504
15	-0.035	-0.114	13.437	0.569
16	0.081	0.035	14.239	0.581
17	-0.076	-0.071	14.944	0.600
18	-0.025	0.021	15.024	0.660
19	-0.097	-0.103	16.210	0.643
20	0.191	0.199	20.843	0.406
21	-0.154	-0.143	23.905	0.298
22	-0.121	-0.052	25.805	0.260
23	-0.096	-0.090	27.029	0.255
24	-0.017	-0.035	27.067	0.301
25	-0.026	0.030	27.159	0.348
26	-0.104	-0.054	28.657	0.327
27	0.033	0.131	28.808	0.370
28	-0.070	-0.102	29.510	0.387
29	-0.052	0.062	29.905	0.419
30	0.110	0.078	31.669	0.383
31	-0.099	0.004	33.131	0.364
32	-0.036	-0.027	33.327	0.403
33	-0.077	0.002	34.234	0.408
34	0.004	-0.035	34.236	0.456
35	0.034	0.066	34.418	0.496
36	0.078	0.047	35.399	0.497

Breusch-Godfrey Serial Correlation LM Test:

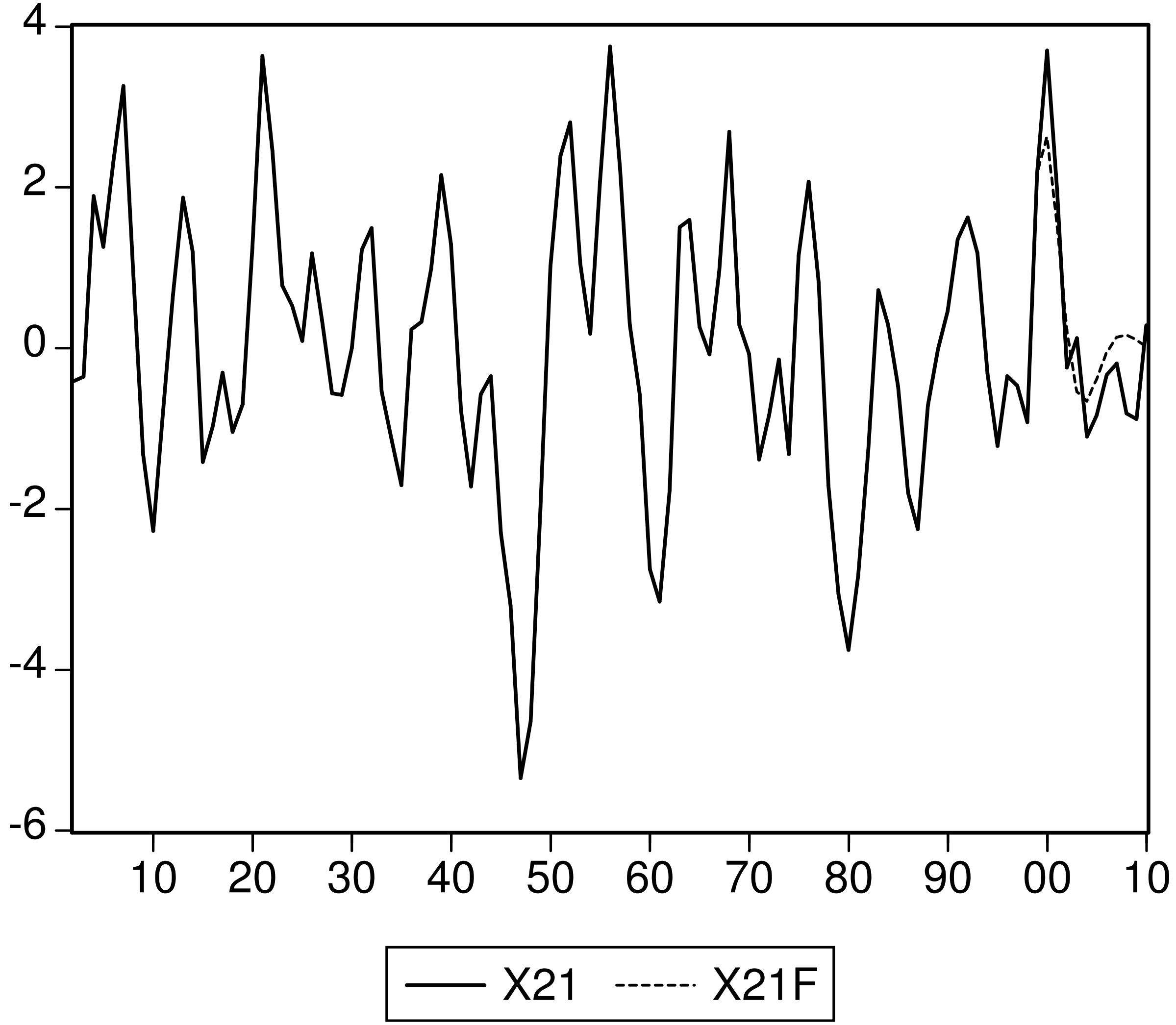
F-statistic	0.525185	Probability	0.593153
Obs*R-squared	1.093562	Probability	0.578810

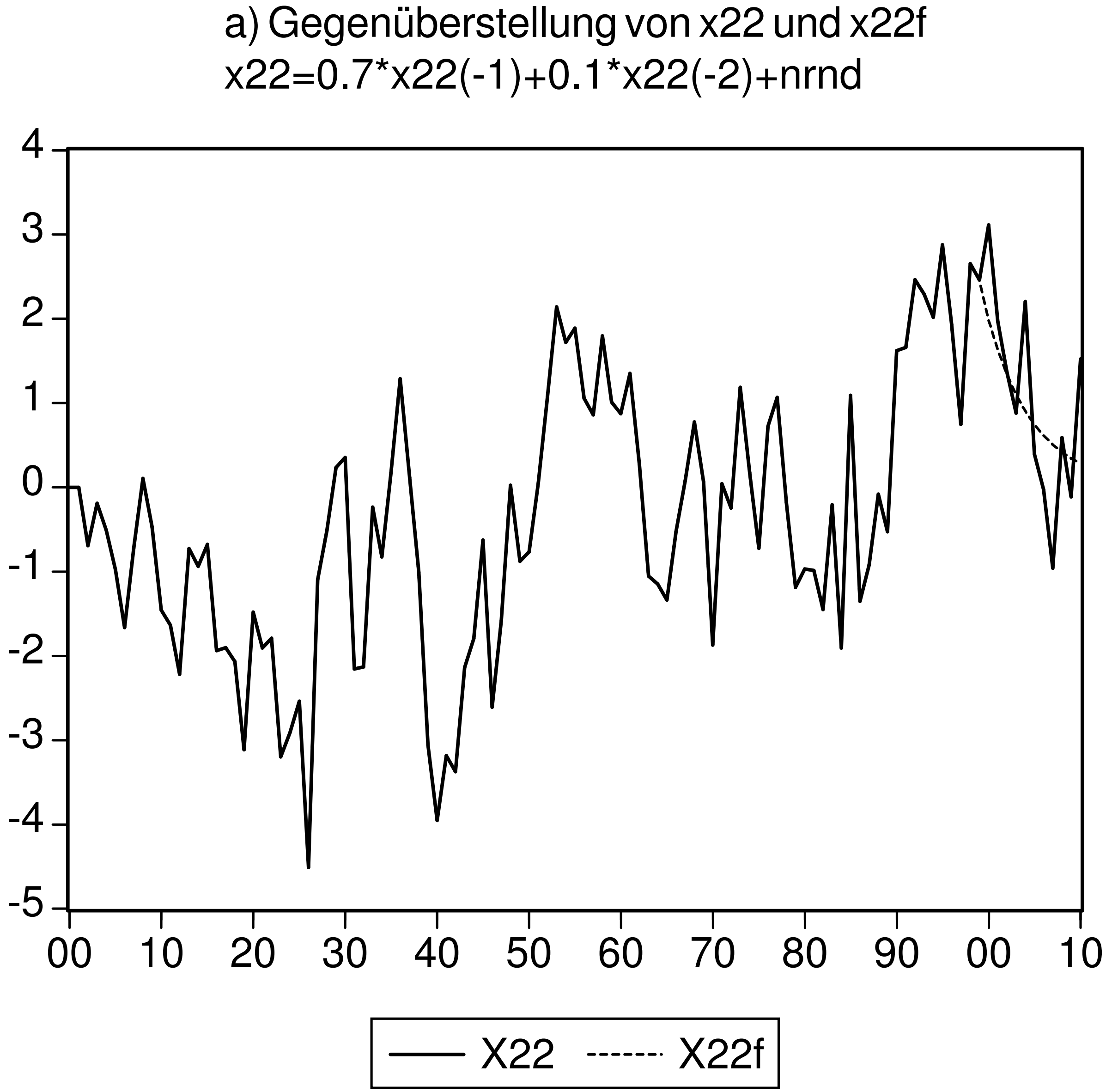
Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 05/17/07 Time: 12:38
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.020472	0.031451	0.650935	0.5167
DELTA_R1(-1)	0.004478	0.200717	0.022309	0.9822
DELTA_R3(-1)	0.410812	0.553890	0.741685	0.4601
RESID(-1)	-0.407363	0.547382	-0.744203	0.4586
RESID(-2)	-0.198826	0.196994	-1.009301	0.3154

R-squared	0.010936	Mean dependent var	1.11E-18
Adjusted R-squared	-0.030709	S.D. dependent var	0.167486
S.E. of regression	0.170038	Akaike info criterion	-0.656880
Sum squared resid	2.746736	Schwarz criterion	-0.526621
Log likelihood	37.84398	F-statistic	0.262593
Durbin-Watson stat	2.013658	Prob(F-statistic)	0.901261

a) Gegenüberstellung von x21 und x21f
x21=1*x21(-1).0.5*x21(-2)+nrnd





a) Gegenüberstellung von x22 und x22f
x22=0.7*x22(-1)+0.1*x22(-2)+nrnd
4
3
2
1
0
-1
-2
-3
-4
-5
00
10
20
30
40
50
60
70
80
90
00
10
X22
X22f

b) Least Squares 1

Dependent Variable: X21
Method: Least Squares
Date: 05/31/07 Time: 10:39
Sample: 2002 2099
Included observations: 98
Convergence achieved after 7 iterations
Backcast: 2001

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.016643	0.187116	0.088947	0.9293
X21(-1)	0.451612	0.112903	4.000014	0.0001
MA(1)	0.604099	0.100400	6.016909	0.0000

R-squared	0.570841	Mean dependent var	-0.019223
Adjusted R-squared	0.561806	S.D. dependent var	1.747363
S.E. of regression	1.156689	Akaike info criterion	3.159134
Sum squared resid	127.1032	Schwarz criterion	3.238265
Log likelihood	-151.7975	F-statistic	63.18148
Durbin-Watson stat	1.848785	Prob(F-statistic)	0.000000

Inverted MA Roots -.60

b) Least Squares 2

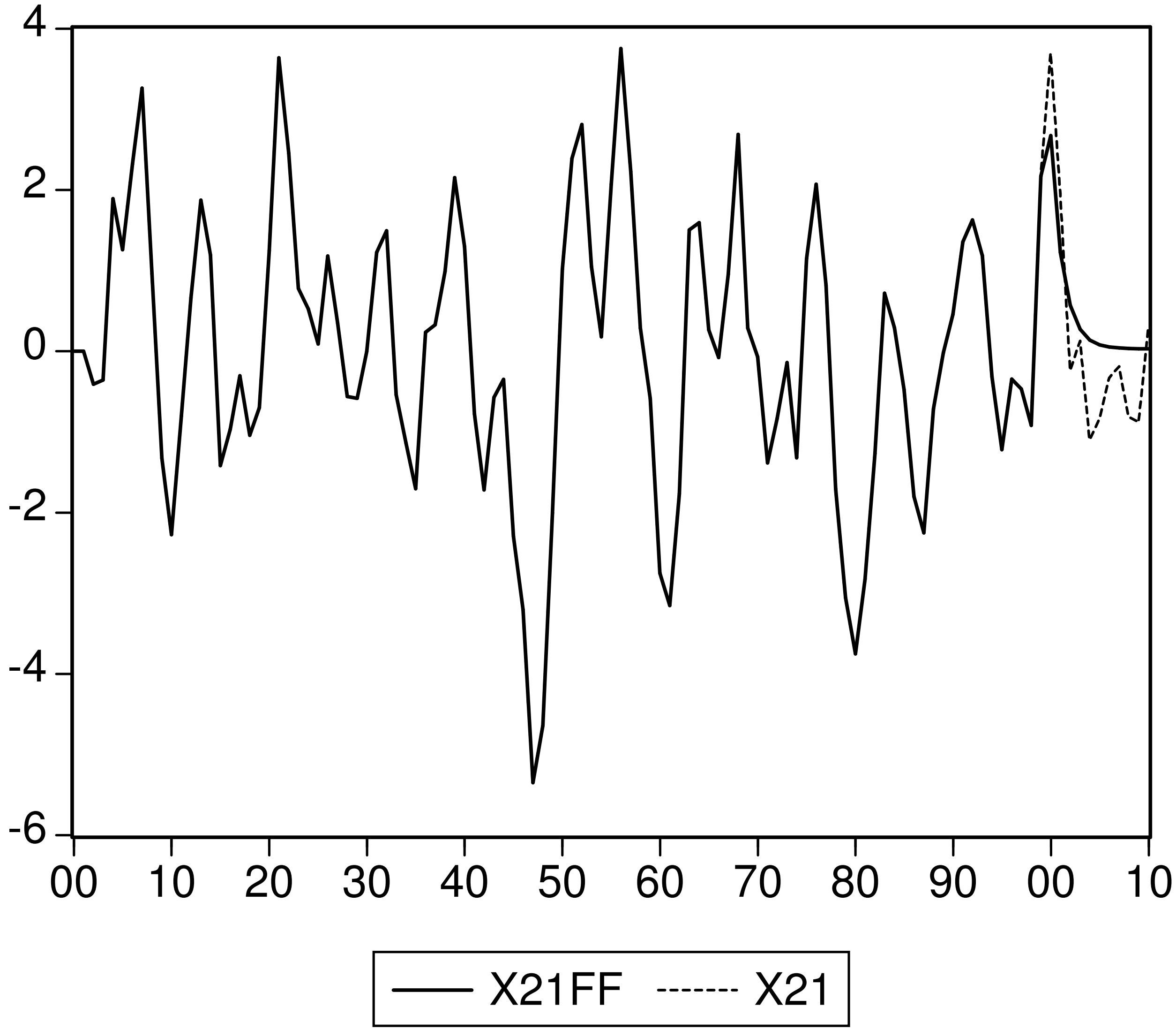
Dependent Variable: X22
Method: Least Squares
Date: 05/31/07 Time: 10:43
Sample: 2002 2099
Included observations: 98
Convergence achieved after 4 iterations
Backcast: 2001

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.052108	0.094145	-0.553487	0.5812
X22(-1)	0.845286	0.077283	10.93759	0.0000
MA(1)	-0.199056	0.133301	-1.493286	0.1387

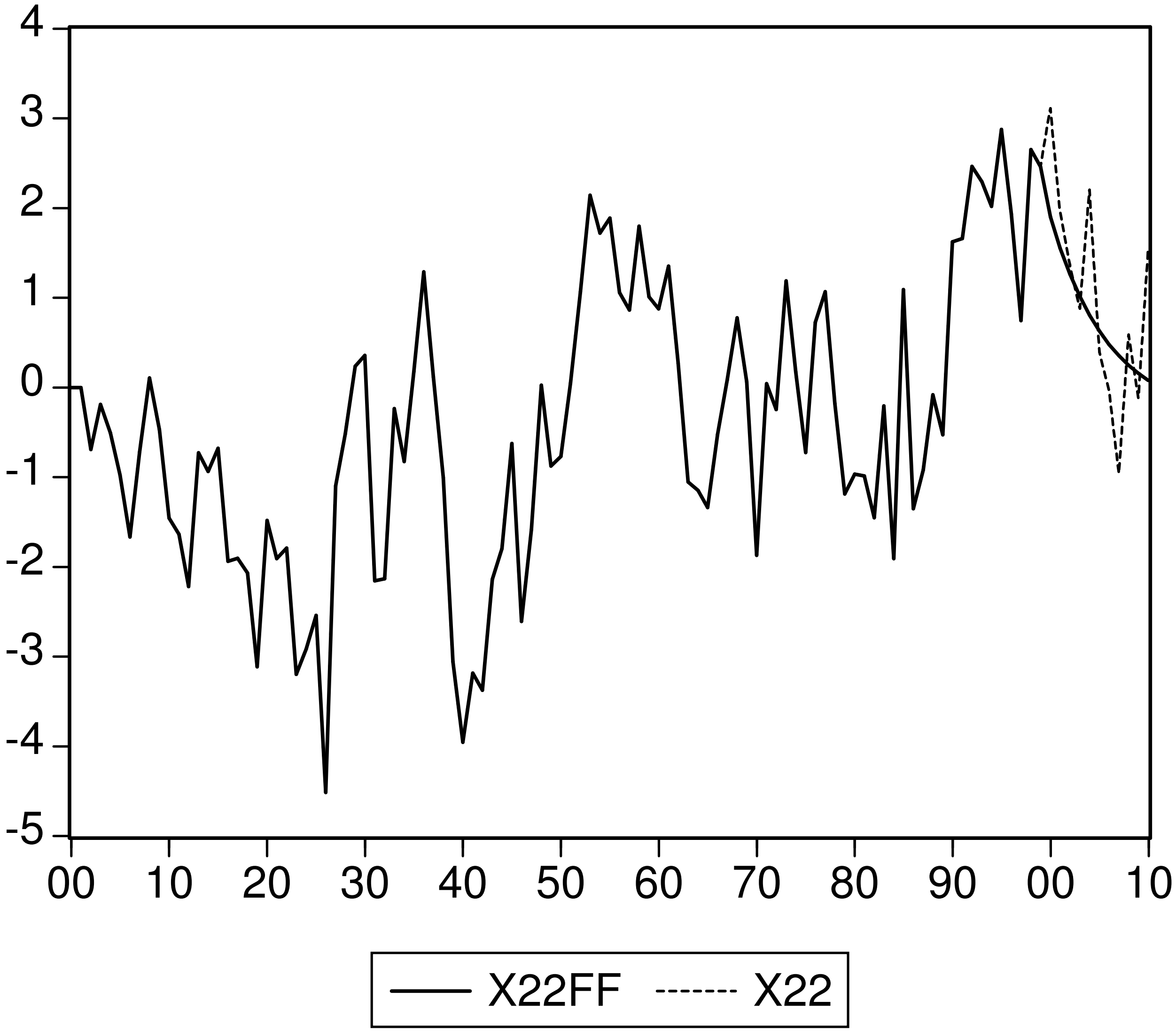
R-squared	0.561742	Mean dependent var	-0.474164
Adjusted R-squared	0.552516	S.D. dependent var	1.583774
S.E. of regression	1.059454	Akaike info criterion	2.983518
Sum squared resid	106.6320	Schwarz criterion	3.062649
Log likelihood	-143.1924	F-statistic	60.88376
Durbin-Watson stat	1.992714	Prob(F-statistic)	0.000000

Inverted MA Roots	.20

b) falsche Vorhersage mit ARMA(1,1) 1



b) falsche Vorhersage mit ARMA(1,1) 2



c) Least Squares

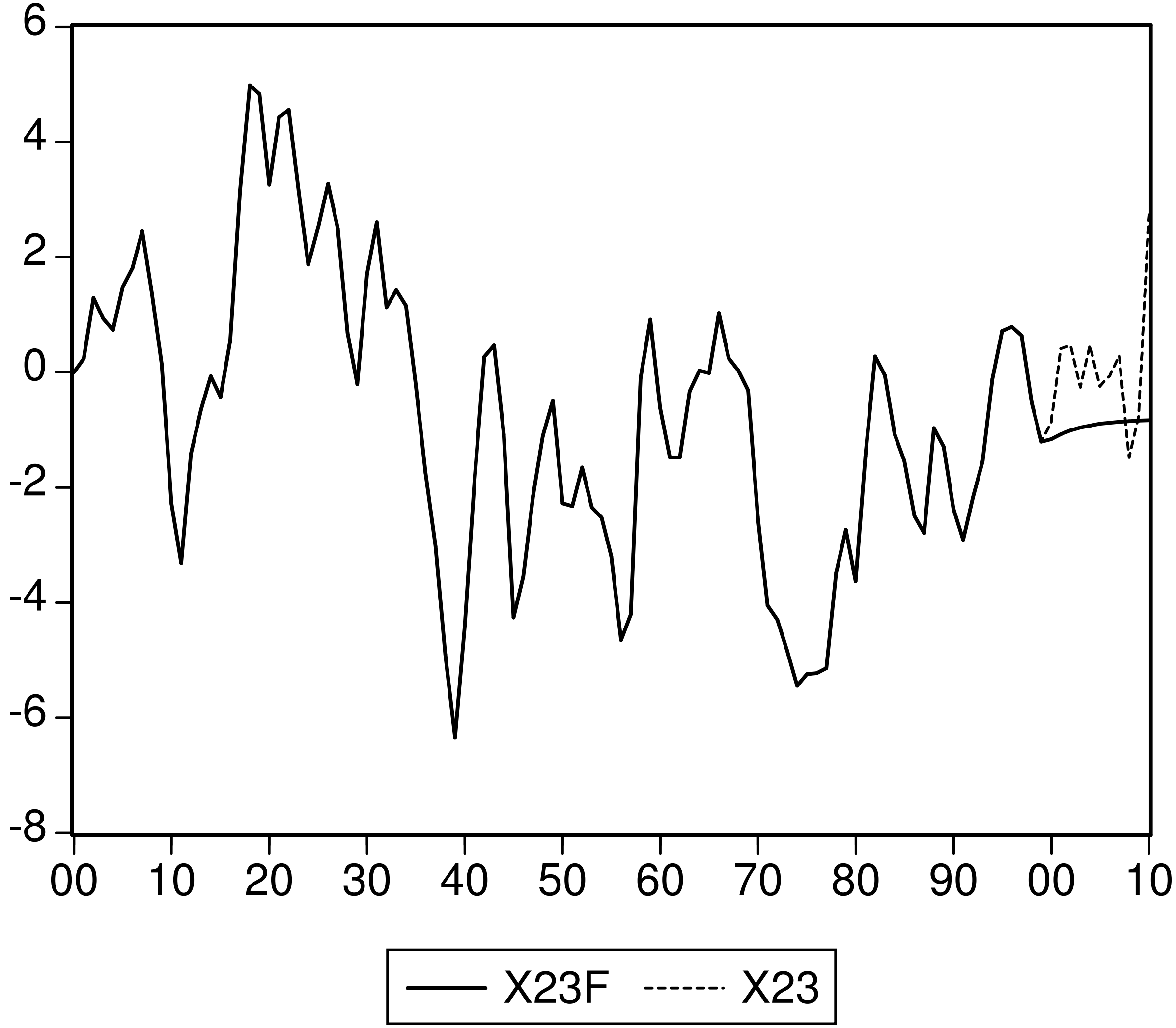
Dependent Variable: X23
Method: Least Squares
Date: 05/31/07 Time: 10:55
Sample: 2001 2099
Included observations: 99
Convergence achieved after 6 iterations
Backcast: 2000

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.199624	0.185199	-1.077886	0.2838
X23(-1)	0.753699	0.070299	10.72136	0.0000
MA(1)	0.709950	0.075382	9.418060	0.0000

R-squared	0.832339	Mean dependent var	-0.772317
Adjusted R-squared	0.828846	S.D. dependent var	2.497189
S.E. of regression	1.033105	Akaike info criterion	2.932850
Sum squared resid	102.4614	Schwarz criterion	3.011490
Log likelihood	-142.1761	F-statistic	238.2923
Durbin-Watson stat	2.010429	Prob(F-statistic)	0.000000

Inverted MA Roots -.71

c) Vorhersage eines ARMA(1,1)
x23=0.75*c23(-1)+0.75*eps(-1)+eps



d) Dynamische Vorhersage

System: SIMULTAN
Estimation Method: Least Squares
Date: 08/05/07 Time: 14:30
Sample: 2001 2099
Included observations: 99
Total system (unbalanced) observations 197

	Coefficient	Std. Error	t-Statistic	Prob.
C(11)	0.013788	0.112640	0.122409	0.9027
C(12)	0.856733	0.054767	15.64318	0.0000
C(13)	0.016531	0.067653	0.244350	0.8072
C(21)	0.006864	0.113301	0.060582	0.9518
C(22)	1.038872	0.090203	11.51706	0.0000
C(23)	-0.527784	0.090323	-5.843270	0.0000

Determinant residual covariance 1.478607

Equation: Y=C(11)+C(12)*Y(-1) +C(13)*X21
Observations: 99

R-squared	0.735142	Mean dependent var	-0.013149
Adjusted R-squared	0.729624	S.D. dependent var	2.155112
S.E. of regression	1.120607	Sum squared resid	120.5530
Durbin-Watson stat	2.054977		

Equation: X21=C(21)+C(22)*X21(-1)+C(23)*X21(-2)
Observations: 98

R-squared	0.596702	Mean dependent var	-0.019223
Adjusted R-squared	0.588211	S.D. dependent var	1.747363
S.E. of regression	1.121296	Sum squared resid	119.4440
Durbin-Watson stat	1.882447		

d) Dynamische Vorhersage (nur sign. Regressoren)

System: SIMULTAN
Estimation Method: Least Squares
Date: 08/05/07 Time: 14:35
Sample: 2001 2099
Included observations: 99
Total system (unbalanced) observations 197

	Coefficient	Std. Error	t-Statistic	Prob.
C(12)	0.860272	0.052187	16.48448	0.0000
C(22)	1.038788	0.089723	11.57774	0.0000
C(23)	-0.527800	0.089853	-5.874034	0.0000

Determinant residual covariance 1.476691

Equation: Y=C(12)*Y(-1)
Observations: 99

R-squared	0.734937	Mean dependent var	-0.013149
Adjusted R-squared	0.734937	S.D. dependent var	2.155112
S.E. of regression	1.109542	Sum squared resid	120.6463
Durbin-Watson stat	2.062632		

Equation: X21=C(22)*X21(-1)+C(23)*X21(-2)
Observations: 98

R-squared	0.596686	Mean dependent var	-0.019223
Adjusted R-squared	0.592485	S.D. dependent var	1.747363
S.E. of regression	1.115462	Sum squared resid	119.4486
Durbin-Watson stat	1.882216		

Goethe-Universität Frankfurt
Statistik und Methoden der Ökonometrie
Prof. Dr. Uwe Hassler
Finanzökonometrie Sommersemester 2007

6. Übung: Theoretische Eigenschaften von (G)ARCH

a) Zeigen Sie, dass die Kurtosis γ_2 eines ARCH-Prozesses den Wert 3 übersteigt. Unterstellen Sie dazu Normalverteilung von ε_t und $\mathrm{E}(\sigma_t^4) < \infty$.

b) Berechnen Sie die Kurtosis eines ARCH(1)-Prozesses für den Fall, dass sie endlich existiert. Unterstellen Sie dazu Normalverteilung von ε_t.

c) Unterstellen Sie, dass y_t ein stationärer GARCH-Prozess ist. Bestimmen Sie einen Ausdruck für die Varianz.

Finanzökonometrie **SS 07**
Prof. Dr. Hassler
6. Übung

Für die Herleitungen werden folgende Eigenschaften und Gleichungen benötigt.

$$\varepsilon \sim N(0,1); \quad E(\sigma_t^4) < \infty; \quad y_t = \sigma_t \cdot \varepsilon_t; \quad \sigma_t^2 = \alpha_0 + \alpha_1 \cdot y_{t-1}^2 + \ldots + \alpha_p \cdot y_{t-p}$$

a) Die Kurtosis eines ARCH-Prozesses übersteigt den Wert 3

$$\gamma_2 = \frac{E(y_t - \mu)^4}{(E(y_t - \mu)^2)^2}$$

$$\gamma_2 = \frac{E(y_t^4)}{(E(y_t)^2)^2}$$

$$\gamma_2 = \frac{E(\sigma_t \cdot \varepsilon_t^4)}{(E(\sigma_t^2 \cdot \varepsilon_t^2))^2}$$

$$\gamma_2 = \frac{E(\sigma^4) \cdot E(\varepsilon_t^4)}{(E(\sigma_t^2) \cdot E(\varepsilon_t^2))^2}$$

$$\gamma_2 = \frac{3 \cdot E(\sigma_t^4)}{(1 \cdot E(\sigma_t^2))^2}$$

$$\text{wenn } E(\sigma_t^4) > (E(\sigma_t^2))^2 \text{ ist der obige Ausdruck} > 3$$

$$\text{bzw. wenn } E(\sigma_t^4) - (E(\sigma_t^2))^2 > 0$$

$$\text{Definiere}: \sigma_t^2 := X \Leftrightarrow \sigma_t^4 = X^2$$

$$\text{Verschiebungssatz}: E(X^2) - (E(X))^2 = Var(X) = Var(\sigma_t^2) > 0$$

$$q.e.d.$$

b) Berechnung der Kurtosis eines ARCH(1) Prozesses

$$\gamma_2 = \frac{E(y_t - \mu)^4}{(E(y_t - \mu^2))^2}$$

$$\gamma_2 = \frac{(1-\alpha_1)^2}{\alpha_0^2} \cdot E(y_t)^4$$

$$\gamma_2 = \frac{(1-\alpha_1)^2}{\alpha_0^2} \cdot E(\varepsilon^4) \cdot E(\sigma_t^4)$$

$$\gamma_2 = \frac{3 \cdot (1-\alpha_1)^2}{\alpha_0^2} \cdot E(\alpha_0 + \alpha_1 \cdot y_{t-1})^2$$

$$\gamma_2 = \frac{3 \cdot (1-\alpha_1)^2}{\alpha_0^2} \cdot E(\alpha_0^2 + 2 \cdot \alpha_0 \cdot \alpha_1 \cdot y_{t-1}^2 + \alpha_1^2 \cdot y_{t-1}^4)$$

$$\gamma_2 = \frac{3 \cdot (1-\alpha_1)^2}{\alpha_0^2} \cdot (\alpha_0^2 + 2 \cdot \alpha_0 \cdot \alpha_1 \cdot \frac{\alpha_0}{1-\alpha_1} \cdot 1 + \alpha_1^2 \cdot E(y_{t-1}^4))$$

$$\gamma_2 = \frac{3 \cdot (1-\alpha_1)^2}{\alpha_0^2} \cdot (\alpha_0^2 + \frac{2 \cdot \alpha_0^2 \cdot \alpha_1}{1-\alpha_1} + \alpha_1^2 \cdot \gamma_2 \cdot \frac{\alpha_0^2}{(1-\alpha_1)^2})$$

$$\gamma_2 = \frac{3 \cdot (1-\alpha_1)^2}{\alpha_0^2} \cdot (\alpha_0^2 + \frac{2 \cdot \alpha_0^2 \cdot \alpha_1}{1-\alpha_1} + \alpha_1^2 \cdot \gamma_2 \cdot \frac{\alpha_0^2}{(1-\alpha_1)^2})$$

$$\gamma_2 = \frac{(1-\alpha_1) \cdot (3 \cdot (1-\alpha_1) + 6 \cdot \alpha_1)}{1 - 3 \cdot \alpha_1}$$

$$\gamma_2 = \frac{3 \cdot (1-\alpha_1)^2}{1 - 3 \cdot \alpha_1}$$

c) Bestimmung eines Varianzausdrucks

$$\sigma_t^2 = \alpha_0 + \sum_{j=1}^{p} \alpha_j \cdot y_{t-j}^2 + \sum_{j=1}^{q} \beta_j \cdot \sigma_{t-j}^2$$

$$Var(y_t) = E(y_t^2) = E(\sigma_t^2) = E(\alpha_0 + \sum_{j=1}^{p} \alpha_j \cdot y_{t-j}^2 + \sum_{j=1}^{q} \beta_j \cdot \sigma_{t-j}^2)$$

$$Var(y_t) = \alpha_0 + \sum_{j=1}^{p} \alpha_j \cdot E(y_{t-j}^2) + \sum_{j=1}^{q} \beta_j \cdot E(\sigma_{t-j}^2) \cdot E(\varepsilon_{t-j})$$

$$Var(y_t) = \alpha_0 + \sum_{j=1}^{p} \alpha_j \cdot Var(y_t) + \sum_{j=1}^{q} \beta_j \cdot Var(y_t)$$

$$Var(y_t) = \frac{\alpha_0}{1 - \sum_{j=1}^{p} \alpha_j - \sum_{j=1}^{q} \beta_j}$$

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Finanzökonometrie Sommersemester 2007

7. Übung: Simulieren, Schätzen und Testen von (G)ARCH

a) Betrachten Sie die täglichen Renditen y_t (zur Schließung der New-Yorker Börse) des Standard&Poor500-Indices. Die Daten finden Sie in einer EViews-Datei ("sp-daily") auf unserer Homepage. Die Stichprobe reicht vom 6. April 1999 bis zum 28. März 2003, $t = 1, \dots, T = 1039$.

Berechnen Sie die Volatilität zeitabhängig durch (z. B. mit $B = 20$)

$$s_t^2 = \frac{1}{B} \sum_{i=1}^{B} y_{t-i}^2, \quad t = B+1, \dots, T.$$

Berechnen Sie nun die Volatilität exponentiell geglättet:

$$s_t^2(\lambda) = (1-\lambda)\, y_{t-1}^2 + \lambda\, s_{t-1}^2(\lambda), \quad \lambda \in (0,1)\,,$$

für $t = 2, \dots, T$ mit Startwert $s_1^2(\lambda) = y_1^2$. Wählen Sie dazu

$$\lambda = 0.2, \;\; \lambda = 0.5, \;\; \lambda = 0.8.$$

b) Simulieren Sie nun ARCH(1)-Prozesse y_t für $t = 2, \dots, 500$ mit $\alpha_0 = 1$, $y_1 = 0$ und

$$\alpha_1 = 0.3, \;\; \alpha_1 = 0.6, \;\; \alpha_1 = 0.9.$$

Bestimmen Sie bei bekannten Parametern die wahre Volatilität:

$$\sigma_t^2 = \alpha_0 + \alpha_1\, y_{t-1}^2.$$

Stellen Sie σ_t den Quadraten y_{t-1}^2 grafisch gegenüber.

Schätzen Sie nun die Parameter α_0 und α_1 und bestimmen Sie

$$\widehat{\sigma}_t^2 = \widehat{\alpha}_0 + \widehat{\alpha}_1\, y_{t-1}^2.$$

Und vergleichen Sie σ_t mit $\widehat{\sigma}_t$.

c) Simulieren Sie nun GARCH(1,1)-Prozesse y_t für $t = 2, \dots, 500$ mit $\alpha_0 = 1$, $\alpha_1 = 0.4$, $y_1 = 0$ und

$$\beta_1 = 0.2, \;\; \beta_1 = 0.4, \;\; \beta_1 = 0.6.$$

Schätzen Sie die Parameter und bestimmen Sie

$$\widehat{\sigma}_t^2 = \widehat{\alpha}_0 + \widehat{\alpha}_1\, y_{t-1}^2 + \widehat{\beta}_1\, \sigma_{t-1}^2.$$

d) Führen sie mit ausgewählten Reihen aus a) bis c) ARCH-Tests durch (Jarque-Bera, ARCH-LM, Box-Pierce der Quadrate).

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8. Übung: GARCH und Erweiterungen

Laden Sie die EViews-Datei *sp-daily* mit täglichen Werten des Standard&Poor500-Indices. Es stehe Y_t für diese Zeitreihe. Siehe auch 7. Übung.

1. Berechnen Sie die Rendite $y_t = \Delta \log(Y_t)$ und deren arithmetisches Mittel. Erscheint dieses significant von Null verschieden?

2. Betrachten Sie das Autokorrelogramm der (quadrierten) Renditen. Testen Sie formal die Nullhypothesen der seriellen Unkorreliertheit. Was können Sie damit über die zeitliche Unabhängigkeit der Renditen sagen?

3. Testen Sie die Nullhypothese, dass die Renditen normalverteilt sind.

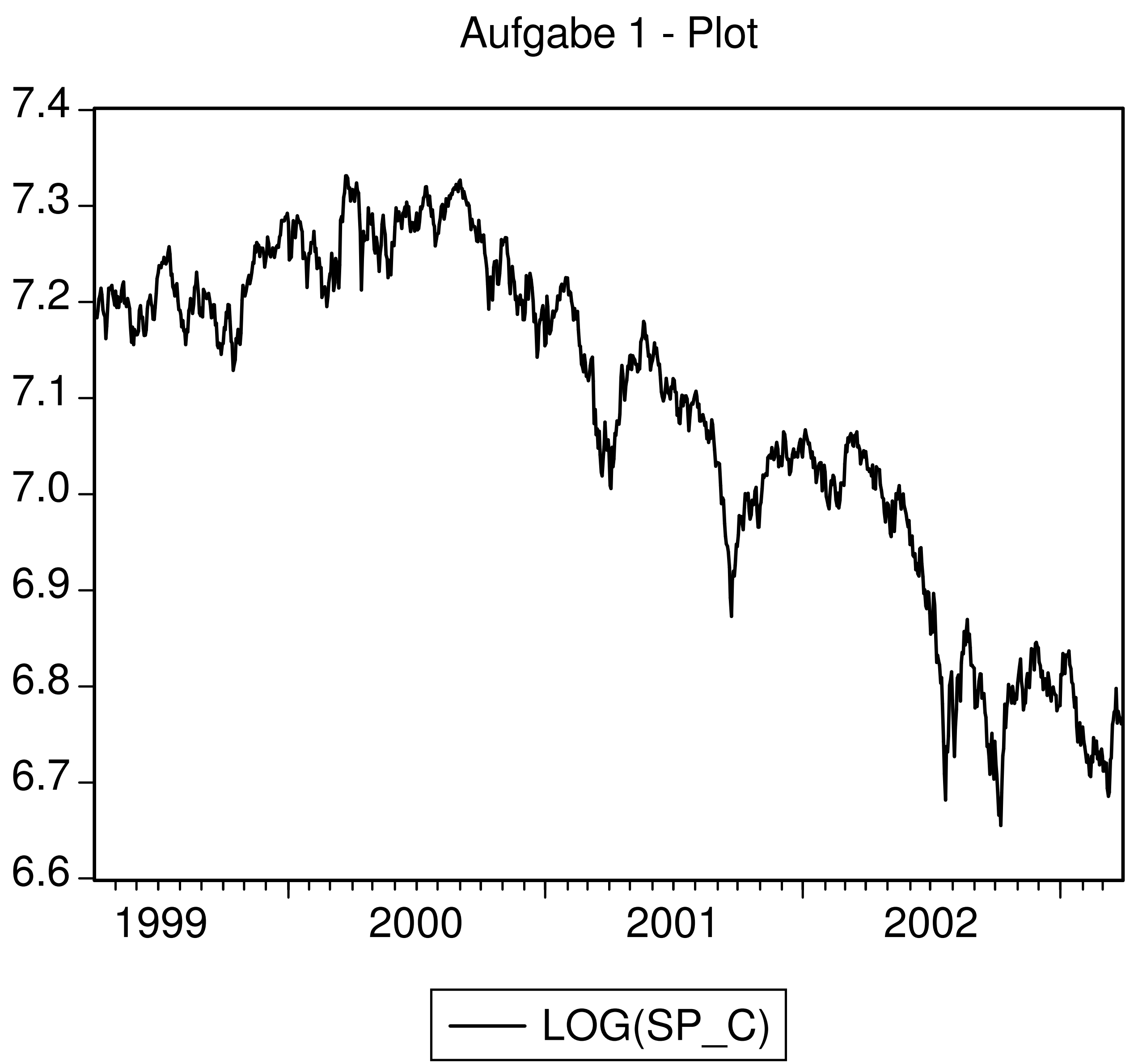
4. Testen Sie formal die Nullhypothese, dass in den Renditen keine ARCH-Effekte bis zur 5. Ordnung vorliegen.

5. Passen Sie den Renditen ein (G)ARCH-Modell (mit konstanter Erwartungswertfunktion) an:
$$y_t = \mu + \text{GARCH}\,.$$
Scheint der geschätzte Erwartungswert nunmehr signifikant von Null verschieden? Überprüfen Sie, ob die Residuen noch ARCH-Effekte aufweisen.

6. Speichern Sie die geschätzte bedingte Volatilität $\widehat{\sigma}_t^2$, die aus Ihrem GARCH-Modell resultiert. Schätzen Sie damit nunmehr das Modell:
$$y_t = \mu + \theta\,\widehat{\sigma}_t^2 + \text{GARCH} \quad \text{oder} \quad y_t = \mu + \theta\,\widehat{\sigma}_t + \text{GARCH}\,.$$
Hat die Volatilität einen signifikanten (positiven) Einfluss auf das Niveau der Renditen? Ist die Schätzung für μ nunmehr signifikant von Null verschieden?

7. Schätzen Sie nun ein GARCH-M-Modell, und vergleichen Sie die Ergebnisse mit voriger Schätzung.

8. Passen Sie schließlich den Daten ein EGARCH-Modell an und testen Sie, ob der Leverage-Effekt signifikant ist.


Aufgabe 1 - Plot
7.4
7.3
7.2
7.1
7.0
6.9
6.8
6.7
6.6
1999
2000
2001
2002
LOG(SP_C)

Aufgabe 1 - Least Squares

Dependent Variable: R
Method: Least Squares
Date: 06/07/07 Time: 10:06
Sample(adjusted): 4/06/1999 3/28/2003
Included observations: 1039 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.000409	0.000427	-0.957697	0.3384

R-squared	0.000000	Mean dependent var	-0.000409
Adjusted R-squared	0.000000	S.D. dependent var	0.013775
S.E. of regression	0.013775	Akaike info criterion	-5.730924
Sum squared resid	0.196968	Schwarz criterion	-5.726164
Log likelihood	2978.215	Durbin-Watson stat	2.011307

Aufgabe 2 - Correlogram of Residuals (nicht quadriert!)

Date: 06/07/07 Time: 10:16
Sample: 4/06/1999 3/28/2003
Included observations: 1039

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	-0.006	-0.006	0.0343	0.853
		2	-0.038	-0.038	1.5070	0.471
		3	-0.055	-0.056	4.7019	0.195
		4	0.000	-0.002	4.7020	0.319
		5	-0.025	-0.029	5.3337	0.377
		6	-0.020	-0.023	5.7367	0.453
		7	-0.009	-0.011	5.8168	0.561
		8	0.010	0.005	5.9240	0.656
		9	-0.010	-0.014	6.0370	0.736
		10	0.005	0.004	6.0676	0.810
		11	-0.034	-0.036	7.3073	0.774
		12	0.039	0.037	8.9328	0.709
		13	0.045	0.044	11.086	0.604
		14	-0.017	-0.018	11.381	0.656
		15	0.004	0.011	11.396	0.724
		16	0.021	0.023	11.845	0.755
		17	0.007	0.007	11.900	0.806
		18	-0.002	0.004	11.906	0.852
		19	-0.054	-0.049	14.968	0.725
		20	-0.073	-0.074	20.571	0.423
		21	-0.027	-0.031	21.328	0.439
		22	-0.008	-0.020	21.396	0.496
		23	0.011	0.002	21.533	0.549
		24	-0.044	-0.051	23.617	0.484
		25	0.028	0.015	24.443	0.494
		26	-0.073	-0.083	30.176	0.260
		27	0.024	0.019	30.775	0.280
		28	0.060	0.055	34.567	0.183
		29	0.005	-0.006	34.591	0.218
		30	-0.003	0.001	34.599	0.258
		31	0.030	0.033	35.593	0.261
		32	-0.020	-0.013	36.039	0.285
		33	0.018	0.029	36.403	0.313
		34	-0.080	-0.071	43.210	0.134
		35	-0.064	-0.070	47.587	0.076
		36	0.019	0.025	47.982	0.087

Aufgabe 2 - Correlogram of Residuals Squared

Date: 06/07/07 Time: 10:24
Sample: 4/06/1999 3/28/2003
Included observations: 1039

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.097	0.097	9.7755	0.002
		2	0.184	0.176	45.002	0.000
		3	0.190	0.165	82.626	0.000
		4	0.095	0.043	92.127	0.000
		5	0.082	0.016	99.203	0.000
		6	0.102	0.047	110.08	0.000
		7	0.119	0.079	124.88	0.000
		8	0.105	0.059	136.41	0.000
		9	0.081	0.018	143.27	0.000
		10	0.118	0.056	157.98	0.000
		11	0.111	0.056	170.89	0.000
		12	0.091	0.032	179.56	0.000
		13	0.080	0.009	186.29	0.000
		14	0.069	0.001	191.30	0.000
		15	0.043	-0.016	193.21	0.000
		16	0.098	0.053	203.29	0.000
		17	0.000	-0.052	203.29	0.000
		18	0.116	0.069	217.52	0.000
		19	0.086	0.044	225.38	0.000
		20	0.032	-0.020	226.44	0.000
		21	0.134	0.075	245.39	0.000
		22	0.038	-0.018	246.94	0.000
		23	0.005	-0.057	246.96	0.000
		24	0.026	-0.028	247.68	0.000
		25	0.006	-0.022	247.72	0.000
		26	0.065	0.049	252.18	0.000
		27	0.056	0.040	255.58	0.000
		28	0.055	0.014	258.81	0.000
		29	0.032	-0.023	259.94	0.000
		30	0.046	0.007	262.17	0.000
		31	0.047	0.018	264.55	0.000
		32	0.006	-0.033	264.59	0.000
		33	0.036	0.012	265.96	0.000
		34	0.038	0.010	267.55	0.000
		35	-0.006	-0.021	267.59	0.000
		36	0.001	-0.019	267.59	0.000

Aufgabe 2 - Test auf serielle Unkorreliertheit

ARCH Test:

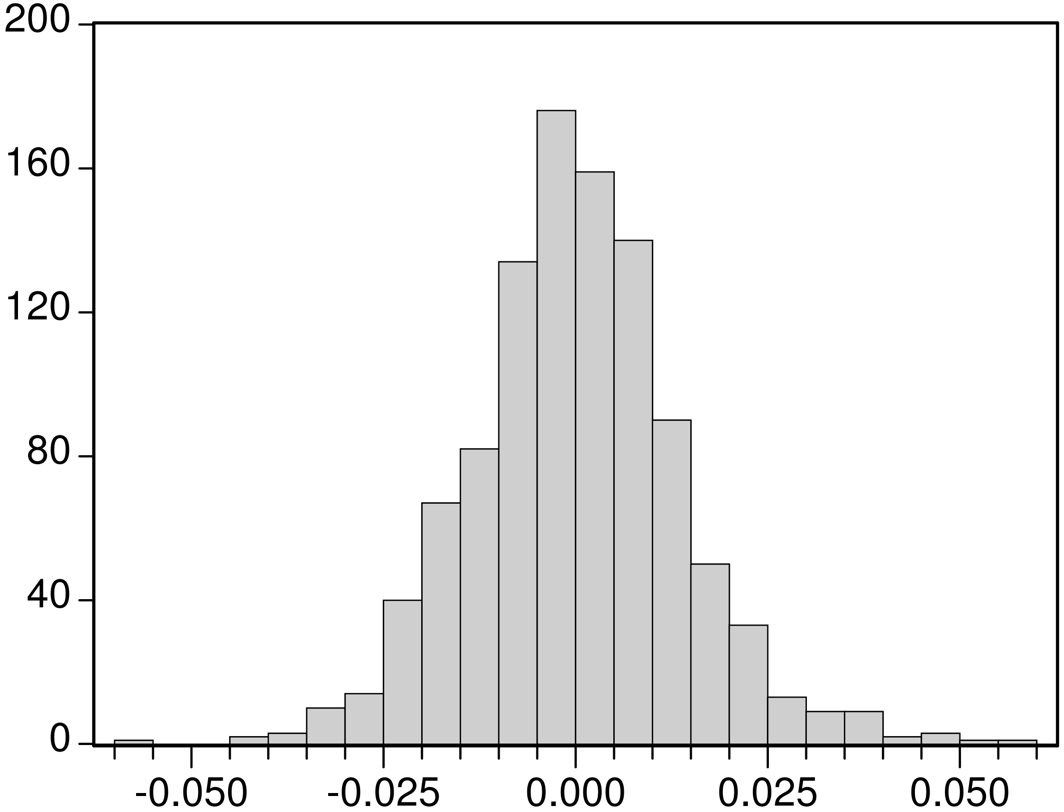
F-statistic	8.009669	Probability	0.000000
Obs*R-squared	88.91968	Probability	0.000000

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 06/07/07 Time: 10:28
Sample(adjusted): 4/22/1999 3/28/2003
Included observations: 1027 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.74E-05	1.64E-05	4.716293	0.0000
RESID^2(-1)	0.026594	0.031373	0.847693	0.3968
RESID^2(-2)	0.139505	0.031360	4.448578	0.0000
RESID^2(-3)	0.141307	0.031635	4.466795	0.0000
RESID^2(-4)	0.014260	0.031938	0.446498	0.6553
RESID^2(-5)	-0.011602	0.032104	-0.361397	0.7179
RESID^2(-6)	0.031904	0.032071	0.994816	0.3201
RESID^2(-7)	0.066076	0.032103	2.058239	0.0398
RESID^2(-8)	0.041861	0.032191	1.300396	0.1938
RESID^2(-9)	0.003627	0.032225	0.112545	0.9104
RESID^2(-10)	0.049800	0.032010	1.555796	0.1201
RESID^2(-11)	0.057003	0.031741	1.795890	0.0728
RESID^2(-12)	0.032657	0.031874	1.024547	0.3058

R-squared	0.086582	Mean dependent var	0.000190
Adjusted R-squared	0.075772	S.D. dependent var	0.000340
S.E. of regression	0.000327	Akaike info criterion	-13.20279
Sum squared resid	0.000108	Schwarz criterion	-13.14033
Log likelihood	6792.635	F-statistic	8.009669
Durbin-Watson stat	2.000859	Prob(F-statistic)	0.000000

Aufgabe 3 - Jarque-Bera-Test



Series: Residuals
Sample 4/06/1999 3/28/2003
Observations 1039

Mean	-5.62E-18
Median	-0.000208
Maximum	0.056154
Minimum	-0.059636
Std. Dev.	0.013775
Skewness	0.220880
Kurtosis	4.182896
Jarque-Bera	69.02398
Probability	0.000000

Aufgabe 5 - (G)ARCH (1,0)

Dependent Variable: R
Method: ML - ARCH (Marquardt) - Normal distribution
Date: 06/25/07 Time: 10:00
Sample (adjusted): 4/06/1999 3/28/2003
Included observations: 1039 after adjustments
Convergence achieved after 8 iterations
Variance backcast: ON
GARCH = C(2) + C(3)*RESID(-1)^2

	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.000354	0.000430	-0.821601	0.4113
Variance Equation				
C	0.000169	8.23E-06	20.48321	0.0000
RESID(-1)^2	0.111732	0.031934	3.498839	0.0005

R-squared	-0.000016	Mean dependent var	-0.000409
Adjusted R-squared	-0.001947	S.D. dependent var	0.013775
S.E. of regression	0.013789	Akaike info criterion	-5.739740
Sum squared resid	0.196972	Schwarz criterion	-5.725459
Log likelihood	2984.795	Durbin-Watson stat	2.011274

Aufgabe 5 - ARCH LM-Test

ARCH Test:

F-statistic	6.032265	Prob. F(12,1014)	0.000000
Obs*R-squared	68.43015	Prob. Chi-Square(12)	0.000000

Test Equation:
Dependent Variable: WGT_RESID^2
Method: Least Squares
Date: 06/25/07 Time: 10:19
Sample (adjusted): 4/22/1999 3/28/2003
Included observations: 1027 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.480566	0.093463	5.141782	0.0000
WGT_RESID^2(-1)	-0.069654	0.031370	-2.220389	0.0266
WGT_RESID^2(-2)	0.123112	0.031429	3.917210	0.0001
WGT_RESID^2(-3)	0.133000	0.031638	4.203760	0.0000
WGT_RESID^2(-4)	0.046312	0.031902	1.451729	0.1469
WGT_RESID^2(-5)	-0.001002	0.032027	-0.031281	0.9751
WGT_RESID^2(-6)	0.019076	0.032003	0.596068	0.5513
WGT_RESID^2(-7)	0.067016	0.032029	2.092350	0.0367
WGT_RESID^2(-8)	0.047593	0.032130	1.481248	0.1389
WGT_RESID^2(-9)	0.016069	0.032137	0.500027	0.6172
WGT_RESID^2(-10)	0.046750	0.031997	1.461068	0.1443
WGT_RESID^2(-11)	0.054221	0.031798	1.705172	0.0885
WGT_RESID^2(-12)	0.038042	0.031898	1.192618	0.2333

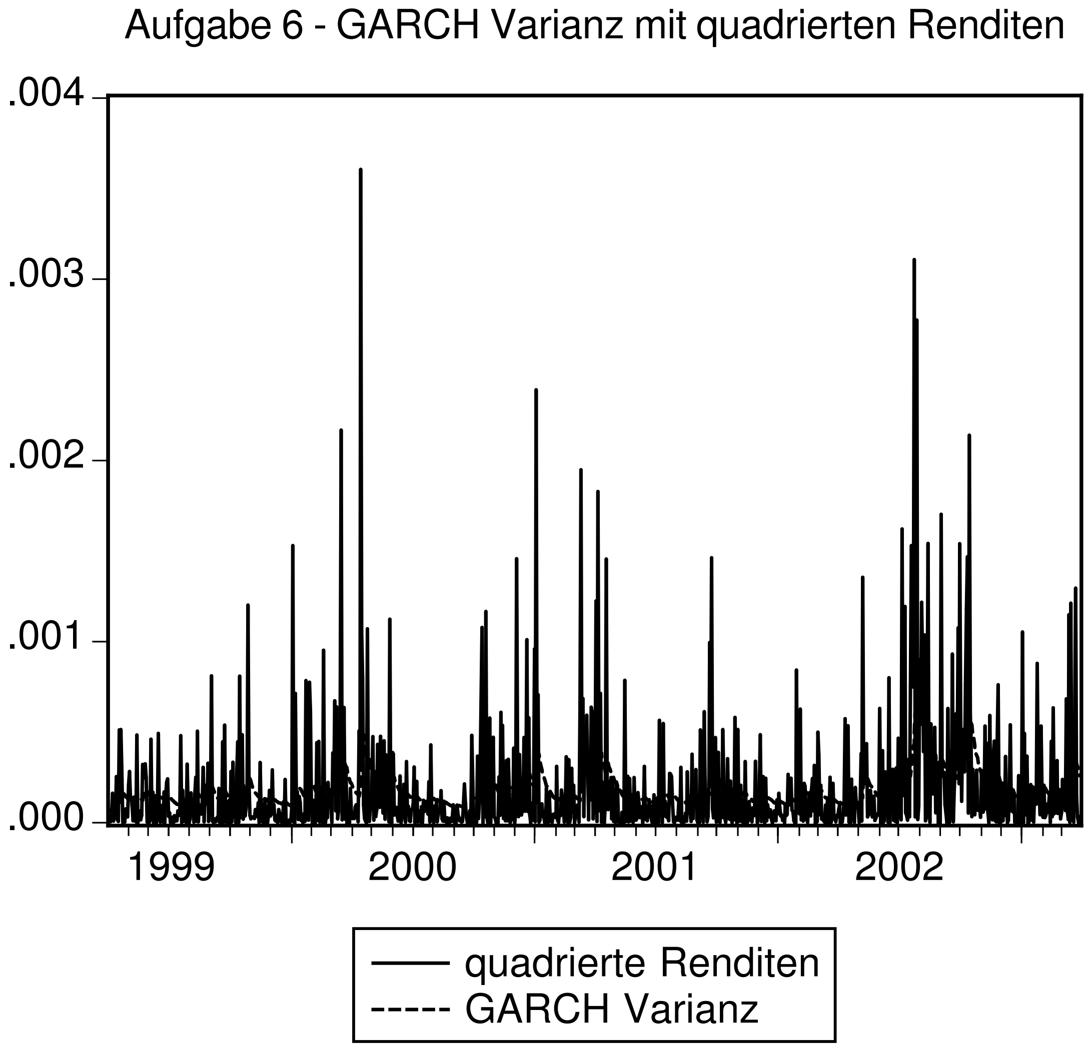
R-squared	0.066631	Mean dependent var	1.001926
Adjusted R-squared	0.055585	S.D. dependent var	1.739900
S.E. of regression	1.690853	Akaike info criterion	3.900920
Sum squared resid	2899.009	Schwarz criterion	3.963381
Log likelihood	-1990.123	F-statistic	6.032265
Durbin-Watson stat	2.001341	Prob(F-statistic)	0.000000

Aufgabe 5 - (G)ARCH (1,1)

Dependent Variable: R
Method: ML - ARCH (Marquardt) - Normal distribution
Date: 06/25/07 Time: 10:24
Sample (adjusted): 4/06/1999 3/28/2003
Included observations: 1039 after adjustments
Convergence achieved after 7 iterations
Variance backcast: ON
GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)

	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.000264	0.000392	-0.673669	0.5005
Variance Equation				
C	7.37E-06	2.54E-06	2.897638	0.0038
RESID(-1)^2	0.073287	0.016790	4.364809	0.0000
GARCH(-1)	0.888441	0.025859	34.35652	0.0000

R-squared	-0.000111	Mean dependent var	-0.000409
Adjusted R-squared	-0.003010	S.D. dependent var	0.013775
S.E. of regression	0.013796	Akaike info criterion	-5.809524
Sum squared resid	0.196990	Schwarz criterion	-5.790482
Log likelihood	3022.048	Durbin-Watson stat	2.011084


Aufgabe 6 - GARCH Varianz mit quadrierten Renditen
.004
.003
.002
.001
.000
1999
2000
2001
2002
quadrierte Renditen
GARCH Varianz

Aufgabe 6 - GARCH-M selbst konstruiert

Dependent Variable: R
Method: Least Squares
Date: 06/25/07 Time: 10:43
Sample (adjusted): 4/06/1999 3/28/2003
Included observations: 1039 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.003212	0.001001	-3.209862	0.0014
GARCH_VARIANZ	14.81394	4.786809	3.094741	0.0020

R-squared	0.009151	Mean dependent var	-0.000409
Adjusted R-squared	0.008196	S.D. dependent var	0.013775
S.E. of regression	0.013719	Akaike info criterion	-5.738193
Sum squared resid	0.195166	Schwarz criterion	-5.728672
Log likelihood	2982.991	F-statistic	9.577424
Durbin-Watson stat	2.034592	Prob(F-statistic)	0.002023

Aufgabe 7 - GARCH-M

Dependent Variable: R
Method: ML - ARCH (Marquardt) - Normal distribution
Date: 06/25/07 Time: 10:29
Sample (adjusted): 4/06/1999 3/28/2003
Included observations: 1039 after adjustments
Convergence achieved after 11 iterations
Variance backcast: ON
GARCH = C(3) + C(4)*RESID(-1)^2 + C(5)*GARCH(-1)

	Coefficient	Std. Error	z-Statistic	Prob.
@SQRT(GARCH)	0.508641	0.171757	2.961400	0.0031
C	-0.006592	0.002148	-3.068839	0.0021
Variance Equation				
C	7.84E-06	2.64E-06	2.975377	0.0029
RESID(-1)^2	0.077263	0.016953	4.557620	0.0000
GARCH(-1)	0.881553	0.025567	34.48042	0.0000

R-squared	0.007392	Mean dependent var	-0.000409
Adjusted R-squared	0.003553	S.D. dependent var	0.013775
S.E. of regression	0.013751	Akaike info criterion	-5.816118
Sum squared resid	0.195512	Schwarz criterion	-5.792316
Log likelihood	3026.473	F-statistic	1.925181
Durbin-Watson stat	2.024508	Prob(F-statistic)	0.104045

Aufgabe 8 - EGARCH

Dependent Variable: R
Method: ML - ARCH (Marquardt) - Normal distribution
Date: 06/25/07 Time: 10:52
Sample (adjusted): 4/06/1999 3/28/2003
Included observations: 1039 after adjustments
Convergence achieved after 27 iterations
Variance backcast: ON
LOG(GARCH) = C(3) + C(4)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(5)*RESID(-1)/@SQRT(GARCH(-1)) + C(6)*LOG(GARCH(-1))

	Coefficient	Std. Error	z-Statistic	Prob.
@SQRT(GARCH)	0.352279	0.124598	2.827332	0.0047
C	-0.005213	0.001484	-3.512127	0.0004
Variance Equation				
C(3)	-0.495851	0.095066	-5.215851	0.0000
C(4)	0.076308	0.022440	3.400522	0.0007
C(5)	-0.133867	0.015564	-8.601306	0.0000
C(6)	0.949747	0.010253	92.63123	0.0000

R-squared	0.009792	Mean dependent var	-0.000409
Adjusted R-squared	0.005000	S.D. dependent var	0.013775
S.E. of regression	0.013741	Akaike info criterion	-5.871141
Sum squared resid	0.195040	Schwarz criterion	-5.842579
Log likelihood	3056.058	F-statistic	2.043113
Durbin-Watson stat	1.982749	Prob(F-statistic)	0.070289

Goethe-Universität Frankfurt
Statistik und Methoden der Ökonometrie
Prof. Dr. Uwe Hassler
Finanzökonometrie Sommersemester 2007

9. Übung: Integrierte Zeitreihen

Erstellen Sie einen Workfile mit jährlichen Beobachtungen von 2001 bis 2500. Erzeugen Sie eine Reihe $\varepsilon 1_t$, die iid und standardnormalverteilt ist.

a) Generieren Sie nun $y1_t = 0.6y1_{t-1} + \varepsilon 1_t$ von 2003 bis 2500 mit den Startwerten $y1_{2001} = y1_{2002} = 0$. Betrachten Sie den Graphen von $y1$ und das Autokorrelogramm.

b) Generieren Sie wieder ab 2003 mit Startwerten Null die Reihe $x1_t = x1_{t-1} + y1_t$. Betrachten Sie den Graphen von $x1$ und das Autokorrelogramm.

c) Generieren Sie wieder ab 2003 mit Startwerten Null die Reihe

$$z1_t = 1.6z1_{t-1} - 0.6z1_{t-2} + \varepsilon 1_t.$$

Vergleichen Sie die Werte von $z1$ und $x1$. Verstehen Sie, warum für alle t gilt: $z1_t = x1_t$?

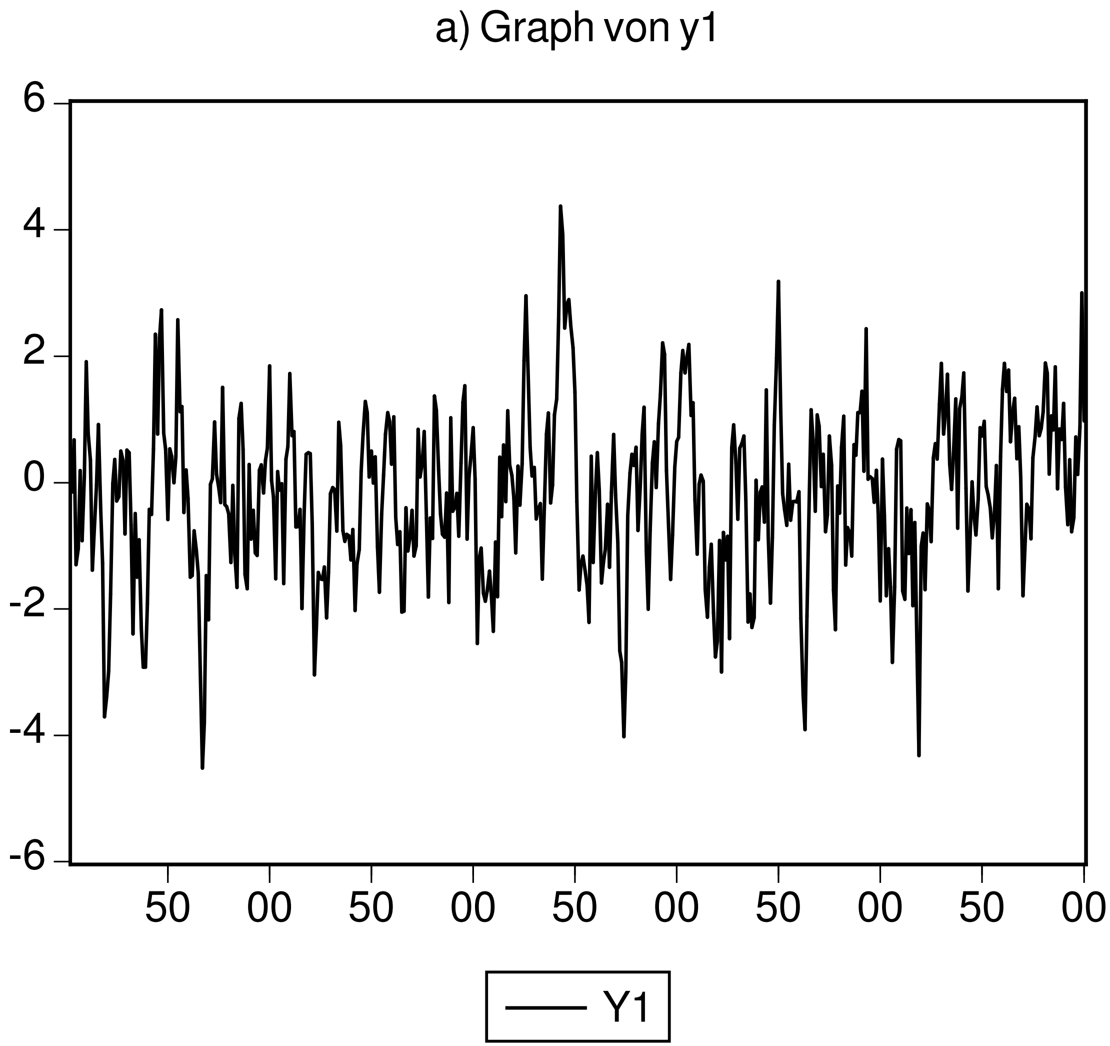
d) Simulieren Sie erneut eine iid $N(0,1)$ Reihe $\varepsilon 2_t$. Generieren Sie wieder ab 2003 mit Startwert Null: $x2_t = x2_{t-1} + \varepsilon 2_t$. Regressieren Sie $x1$ auf $x2$ und eine Konstante. Variieren Sie dabei die Stichprobe. Wie/warum kommt es zu Schein- oder Nonsensregressionen; d.h. zu scheinbar signifikant von Null verschiedenen Schätzungen, obwohl doch $x1$ und $x2$ stochastisch unabhängig sind?!?

e) Regressieren Sie nun die Differenzen $\Delta x1_t$ auf $\Delta x2_t$. Erhalten Sie immer noch Scheinregressionen?

f) Erzeugen Sie schließlich ab 2003:

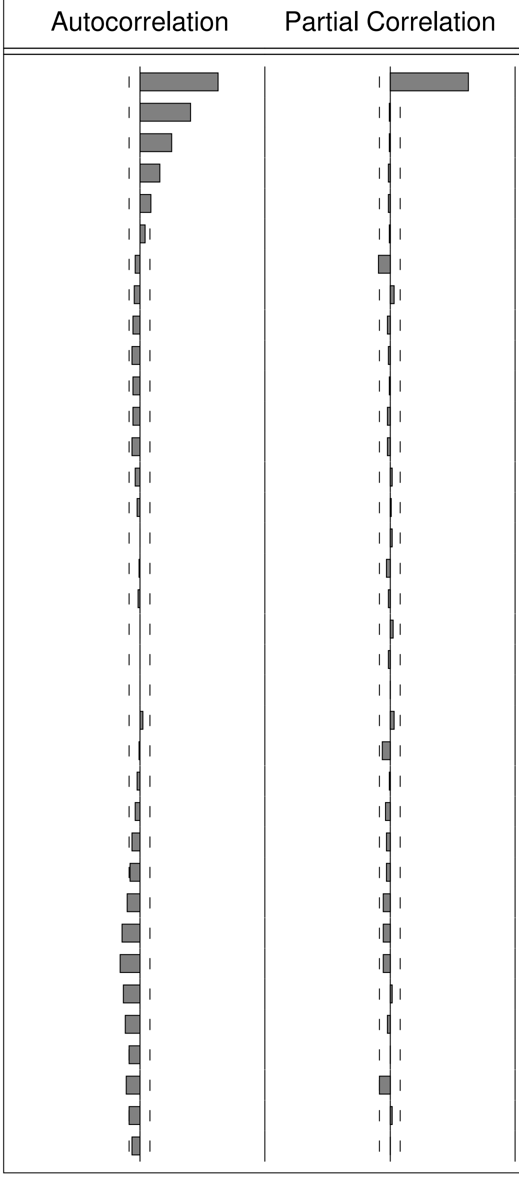
$$x3_t = 5 + x2_t + y1_t.$$

Was ergibt nun die Regression von $x3$ auf $x2$ und eine Konstante? Vergleichen Sie die empirischen Residuen dieser Regression mit $y1$.


a) Graph von y1
6
4
2
0
-2
-4
-6
50
00
50
00
50
00
50
00
50
00
Y1

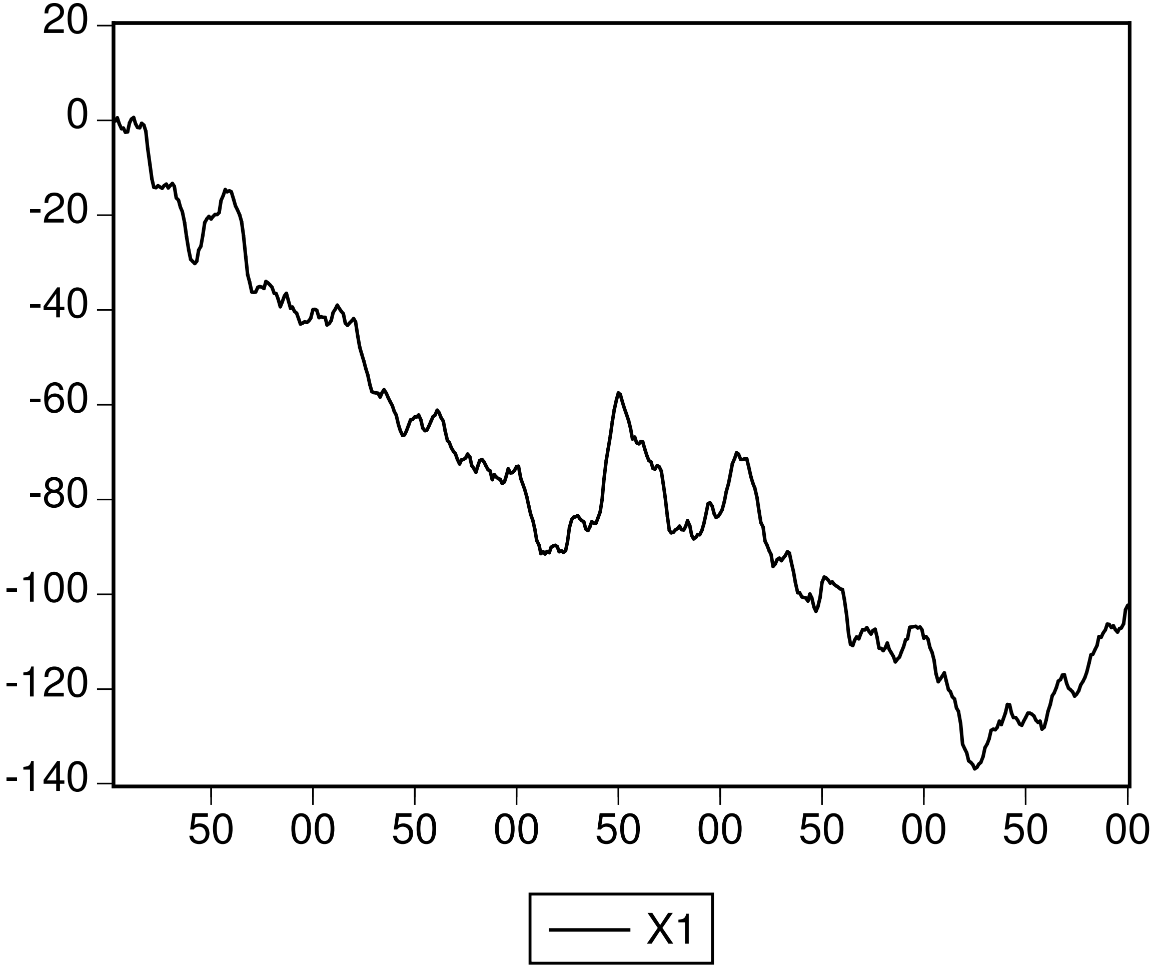
Korrelogramm von y1

Date: 08/06/07   Time: 09:06
Sample: 2003 2500
Included observations: 498



	AC	PAC	Q-Stat	Prob
1	0.649	0.649	211.33	0.000
2	0.420	-0.004	299.80	0.000
3	0.267	-0.007	335.75	0.000
4	0.164	-0.010	349.35	0.000
5	0.093	-0.013	353.70	0.000
6	0.047	-0.007	354.82	0.000
7	-0.033	-0.095	355.37	0.000
8	-0.042	0.036	356.26	0.000
9	-0.054	-0.024	357.75	0.000
10	-0.060	-0.012	359.56	0.000
11	-0.056	-0.002	361.14	0.000
12	-0.057	-0.019	362.80	0.000
13	-0.063	-0.018	364.86	0.000
14	-0.039	0.024	365.62	0.000
15	-0.020	0.008	365.83	0.000
16	0.002	0.017	365.83	0.000
17	-0.004	-0.030	365.84	0.000
18	-0.012	-0.011	365.92	0.000
19	0.001	0.025	365.92	0.000
20	0.003	-0.014	365.93	0.000
21	0.005	0.006	365.94	0.000
22	0.028	0.037	366.35	0.000
23	-0.006	-0.065	366.37	0.000
24	-0.020	-0.003	366.57	0.000
25	-0.040	-0.034	367.40	0.000
26	-0.062	-0.028	369.42	0.000
27	-0.079	-0.027	372.68	0.000
28	-0.106	-0.057	378.64	0.000
29	-0.144	-0.055	389.72	0.000
30	-0.164	-0.051	403.95	0.000
31	-0.139	0.023	414.27	0.000
32	-0.120	-0.017	421.92	0.000
33	-0.090	0.004	426.25	0.000
34	-0.112	-0.083	432.96	0.000
35	-0.090	0.024	437.32	0.000
36	-0.058	0.005	439.11	0.000

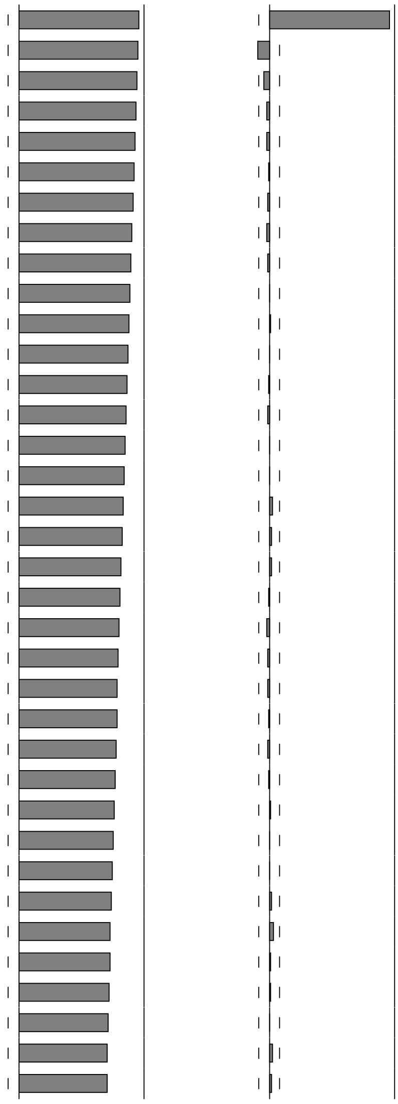
b) Graph von x1



b) Korrelogramm von x1

Date: 08/06/07 Time: 09:11
Sample: 2003 2500
Included observations: 498

Autocorrelation | Partial Correlation



	AC	PAC	Q-Stat	Prob
1	0.994	0.994	495.06	0.000
2	0.987	-0.092	984.15	0.000
3	0.979	-0.045	1466.7	0.000
4	0.972	-0.023	1942.5	0.000
5	0.963	-0.023	2411.3	0.000
6	0.955	-0.005	2873.0	0.000
7	0.947	-0.009	3327.5	0.000
8	0.938	-0.019	3774.8	0.000
9	0.930	-0.008	4214.8	0.000
10	0.921	0.000	4647.6	0.000
11	0.913	0.015	5073.4	0.000
12	0.904	0.000	5492.3	0.000
13	0.896	-0.005	5904.4	0.000
14	0.888	-0.014	6309.7	0.000
15	0.879	0.002	6708.2	0.000
16	0.871	0.001	7100.1	0.000
17	0.863	0.027	7485.8	0.000
18	0.856	0.019	7865.5	0.000
19	0.848	0.018	8239.7	0.000
20	0.841	-0.002	8608.5	0.000
21	0.834	-0.019	8971.7	0.000
22	0.827	-0.016	9329.3	0.000
23	0.819	-0.009	9681.3	0.000
24	0.812	-0.006	10028.	0.000
25	0.804	-0.014	10368.	0.000
26	0.797	-0.007	10703.	0.000
27	0.789	0.010	11033.	0.000
28	0.782	0.000	11357.	0.000
29	0.775	0.002	11675.	0.000
30	0.767	0.017	11989.	0.000
31	0.761	0.036	12297.	0.000
32	0.755	0.012	12602.	0.000
33	0.749	0.016	12902.	0.000
34	0.743	0.004	13198.	0.000
35	0.737	0.025	13490.	0.000
36	0.732	0.024	13780.	0.000

c) Vergleich von x1 und z1

obs	X1	Z1
2001	0.000000	0.000000
2002	0.000000	0.000000
2003	-0.149448	-0.149448
2004	0.526505	0.526505
2005	-0.771043	-0.771043
2006	-1.815190	-1.815190
2007	-1.625096	-1.625096
2008	-2.542602	-2.542602
2009	-2.452797	-2.452797
2010	-0.541719	-0.541719
2011	0.238490	0.238490
2012	0.597113	0.597113
2013	-0.790532	-0.790532
2014	-1.549668	-1.549668
2015	-1.587635	-1.587635
2016	-0.667207	-0.667207
2017	-1.070793	-1.070793
2018	-2.348124	-2.348124
2019	-6.052801	-6.052801
2020	-9.431834	-9.431834
2021	-12.41588	-12.41588
2022	-14.18296	-14.18296
2023	-14.19554	-14.19554
2024	-13.82938	-13.82938
2025	-14.11912	-14.11912
2026	-14.34092	-14.34092
2027	-13.83931	-13.83931
2028	-13.49295	-13.49295
2029	-14.30505	-14.30505
2030	-13.78979	-13.78979
2031	-13.31378	-13.31378
2032	-13.98442	-13.98442
2033	-16.38010	-16.38010
2034	-16.86702	-16.86702
2035	-18.36535	-18.36535
2036	-19.27006	-19.27006
2037	-21.57220	-21.57220
2038	-24.49250	-24.49250
2039	-27.41588	-27.41588
2040	-29.33262	-29.33262
2041	-29.75767	-29.75767
2042	-30.26064	-30.26064
2043	-29.72972	-29.72972
2044	-27.38306	-27.38306
2045	-26.61285	-26.61285
2046	-24.32104	-24.32104
2047	-21.58941	-21.58941
2048	-20.80733	-20.80733
2049	-20.28304	-20.28304
2050	-20.86789	-20.86789
2051	-20.33403	-20.33403
2052	-19.92251	-19.92251
2053	-19.92591	-19.92591
2054	-19.51474	-19.51474
2055	-16.93532	-16.93532
2056	-15.81341	-15.81341
2057	-14.60756	-14.60756
2058	-15.08075	-15.08075
2059	-14.88306	-14.88306
2060	-15.13364	-15.13364

Finanzökonometrie **SS 07**
Prof. Dr. Hassler

9. Übung (Erläuterung zum Aufgabenteil c)

c) „Verstehen Sie, warum für alle t gilt: $z_{1,t}=x_{1,t}$"

$$\boxed{\begin{array}{c} \textit{gegeben sind:} \\ y_{1,t}=0{,}6\, y_{1,t-1}+\varepsilon_{1,t} \\ x_{1,t}=x_{1,t-1}+y_{1,t} \\ z_{1,t}=0{,}16\cdot z_{1,t-1}-0{,}6\cdot z_{1,t-2}+\varepsilon_{1,t} \end{array}}$$

$$y_{1,t}=0{,}6\cdot L\cdot y_{1,t}+\varepsilon_{1,t}$$
$$y_{1,t}-0{,}6\cdot L\cdot y_{1,t}=\varepsilon_{1,t}$$
$$y_{1,t}=\frac{\varepsilon_{1,t}}{1-0{,}6\cdot L}$$
$$\textit{in } x_{1,t} \textit{ eingesetzt:}$$
$$x_{1,t}=x_{1,t-1}+y_{1,t}$$
$$x_{1,t}=L\cdot x_{1,t}+\frac{\varepsilon_{1,t}}{1-0{,}6\cdot L}$$
$$x_{1,t}-L\cdot x_{1,t}=\frac{\varepsilon_{1,t}}{1-0{,}6\cdot L}$$
$$x_{1,t}=\frac{\varepsilon_{1,t}}{(1-0{,}6\cdot L)\cdot(1-L)}$$
$$x_{1,t}=\frac{\varepsilon_{1,t}}{1-1{,}6\cdot L+0{,}6\cdot L^2}$$
$$x_{1,t}\cdot(1-1{,}6\cdot L+0{,}6\cdot L^2)=\varepsilon_{1,t}$$
$$x_{1,t}-1{,}6\cdot x_{1,t-1}+0{,}6\cdot x1_{1,t-2}=\varepsilon_{1,t}$$
$$x_{1,t}=1{,}6\cdot x_{1,t-1}-0{,}6\cdot x_{1,t-2}=\varepsilon_{1,t}$$
$$\textit{verleiche mit:}$$
$$z_{1,t}=1{,}6\cdot z_{1,t-1}-0{,}6\cdot z_{1,t-2}=\varepsilon_{1,t}$$
$$\textit{damit ist für alle } t: z_{1,t}=x_{1,t}$$

d) Scheinregression

Dependent Variable: X1
Method: Least Squares
Date: 08/06/07 Time: 09:25
Sample: 2001 2500
Included observations: 500

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-55.28832	4.208502	-13.13729	0.0000
X2	-1.499592	0.280374	-5.348535	0.0000

R-squared	0.054323	Mean dependent var	-76.21893
Adjusted R-squared	0.052424	S.D. dependent var	35.56632
S.E. of regression	34.62150	Akaike info criterion	9.930819
Sum squared resid	596927.0	Schwarz criterion	9.947677
Log likelihood	-2480.705	F-statistic	28.60683
Durbin-Watson stat	0.003126	Prob(F-statistic)	0.000000

d) Scheinregression 2

Dependent Variable: X1
Method: Least Squares
Date: 08/06/07 Time: 09:26
Sample: 2251 2500
Included observations: 250

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-73.70802	4.506637	-16.35544	0.0000
X2	-2.276332	0.340092	-6.693289	0.0000

R-squared	0.153006	Mean dependent var	-102.8817
Adjusted R-squared	0.149591	S.D. dependent var	19.63907
S.E. of regression	18.11069	Akaike info criterion	8.638850
Sum squared resid	81343.28	Schwarz criterion	8.667021
Log likelihood	-1077.856	F-statistic	44.80012
Durbin-Watson stat	0.019639	Prob(F-statistic)	0.000000

e) Keine Scheinregression bei Differenzen

Dependent Variable: D(X1)
Method: Least Squares
Date: 08/06/07 Time: 10:16
Sample (adjusted): 2002 2500
Included observations: 499 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.204993	0.058716	-3.491250	0.0005
D(X2)	-0.000914	0.062271	-0.014670	0.9883

R-squared	0.000000	Mean dependent var	-0.205011
Adjusted R-squared	-0.002012	S.D. dependent var	1.310012
S.E. of regression	1.311329	Akaike info criterion	3.383960
Sum squared resid	854.6334	Schwarz criterion	3.400844
Log likelihood	-842.2979	F-statistic	0.000215
Durbin-Watson stat	0.699431	Prob(F-statistic)	0.988301

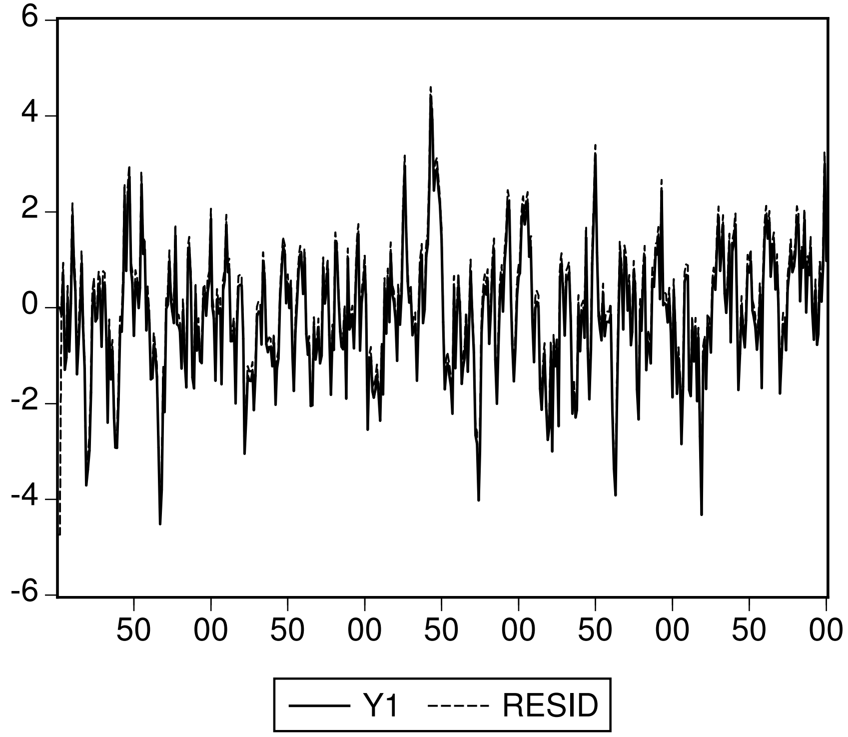
f) Regression

Dependent Variable: X3
Method: Least Squares
Date: 08/06/07 Time: 10:23
Sample: 2001 2500
Included observations: 500

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.733765	0.163436	28.96401	0.0000
X2	1.002983	0.010888	92.11591	0.0000

R-squared	0.944564	Mean dependent var	18.73293
Adjusted R-squared	0.944453	S.D. dependent var	5.704730
S.E. of regression	1.344517	Akaike info criterion	3.433939
Sum squared resid	900.2481	Schwarz criterion	3.450798
Log likelihood	-856.4848	F-statistic	8485.340
Durbin-Watson stat	0.689818	Prob(F-statistic)	0.000000

f) Vergleich von y1 mit den Residuen
der Regression von x3 auf eine Konstante und x2



Goethe-Universität Frankfurt
Statistik und Methoden der Ökonometrie
Prof. Dr. Uwe Hassler
Finanzökonometrie Sommersemester 2007

10. Übung: Einheitswurzeltests

a) Laden Sie die EVIEWS-Datei *unitroot* mit simulierten monatlichen Beobachtungen von 2003.08 bis 2050.12.

1. Betrachten Sie die Schaubilder von
$$y1_t\,, y2_t\,, x1_t \text{ und } x2_t\,, \quad t = 1, \ldots, 569\,.$$
Regressieren Sie
$$x1_t = \widehat{a} + \widehat{b}\,t + \widehat{e1}_t\,,$$
und vergleichen Sie die Residuen $\widehat{e1}$ mit $y1$. Verfahren Sie ebenso mit $x2$ und $y2$.
2. Betrachten Sie die Autokorrelogramme (der Differenzen) von $y1$ und $y2$.
3. Nutzen Sie die EVIEWS-Prozedur *Unit Root Tests*, um einen ADF-Test mit 12 verzögerten Differenzen für $y1$ durchzuführen. Wie können Sie insignifikante Differenzen eliminieren? Und wie können Sie wissen, ob die Residuen frei von serieller Korrelation sind?
4. Regressieren Sie nun mit folgender dynamischer Spezifikation:
$$\Delta z_t = \text{Deterministik} + \phi\, z_{t-1} + a_1\, \Delta z_{t-1} + a_{12}\, \Delta z_{t-12} + \varepsilon_t\,.$$
Testen Sie, ob $y1$, $y2$, $x1$ und $x2$ integriert sind.

b) Laden Sie die EVIEWS-Datei *dj-sp* mit wöchentlichen Beobachtungen des Dow-Jones-Indices (dj). Bezeichnen Sie die Rendite mit
$$y_t = \Delta \log(dj_t)\,.$$
Finden Sie eine Testgleichung, welche erlaubt, die Nullhypothese der Integriertheit (mit Drift) zu verwerfen. Finden Sie eine weitere, bei der H_0 nicht abgelehnt werden kann.

c) Laden Sie die EVIEWS-Datei *Geldzins* mit monatlichen Geldmarktzinssätzen. Testen Sie die Reihen auf Einheitswurzeln. Testen Sie auch die Zinsabstände, z.B. $R3_t - R1_t$.

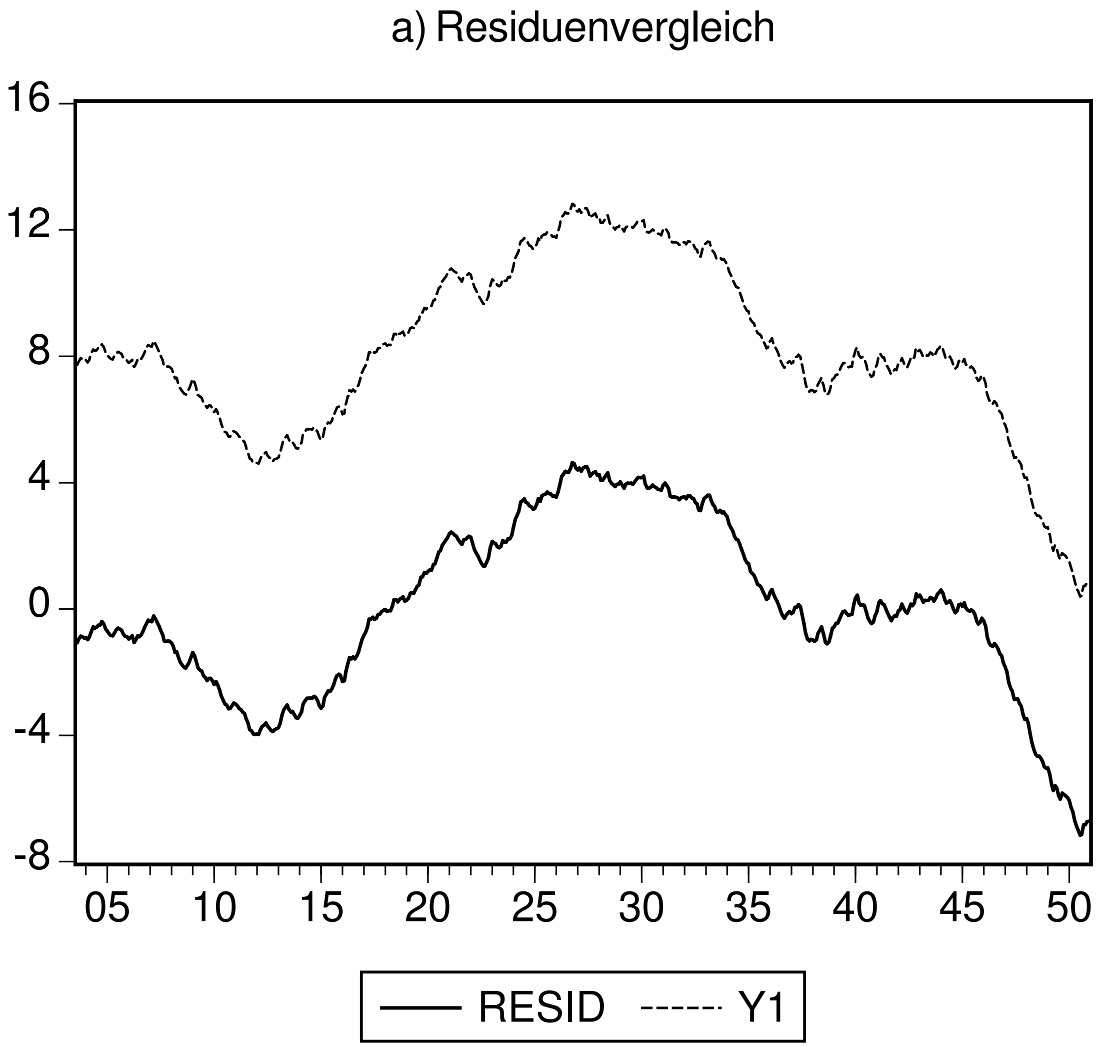
a) Zeitreihen

a) Regression

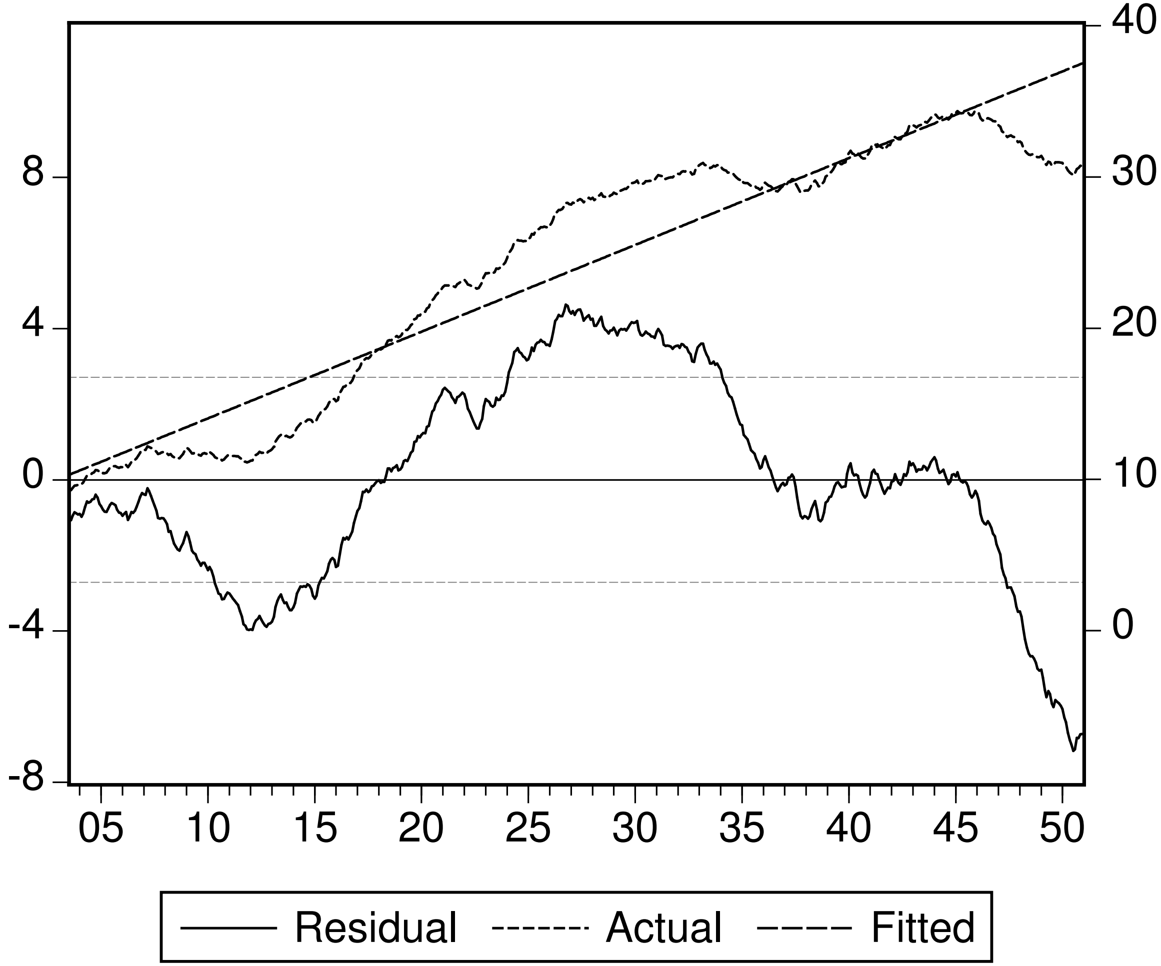
Dependent Variable: X1
Method: Least Squares
Date: 06/29/07 Time: 09:35
Sample: 2003M08 2050M12
Included observations: 569

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	10.34848	0.226891	45.60984	0.0000
@TREND	0.047811	0.000692	69.13355	0.0000

R-squared	0.893948	Mean dependent var	23.92681
Adjusted R-squared	0.893761	S.D. dependent var	8.313326
S.E. of regression	2.709669	Akaike info criterion	4.835039
Sum squared resid	4163.088	Schwarz criterion	4.850307
Log likelihood	-1373.569	F-statistic	4779.448
Durbin-Watson stat	0.002037	Prob(F-statistic)	0.000000


a) Residuenvergleich
16
12
8
4
0
-4
-8
05
10
15
20
25
30
35
40
45
50
RESID
Y1

a) Residuen



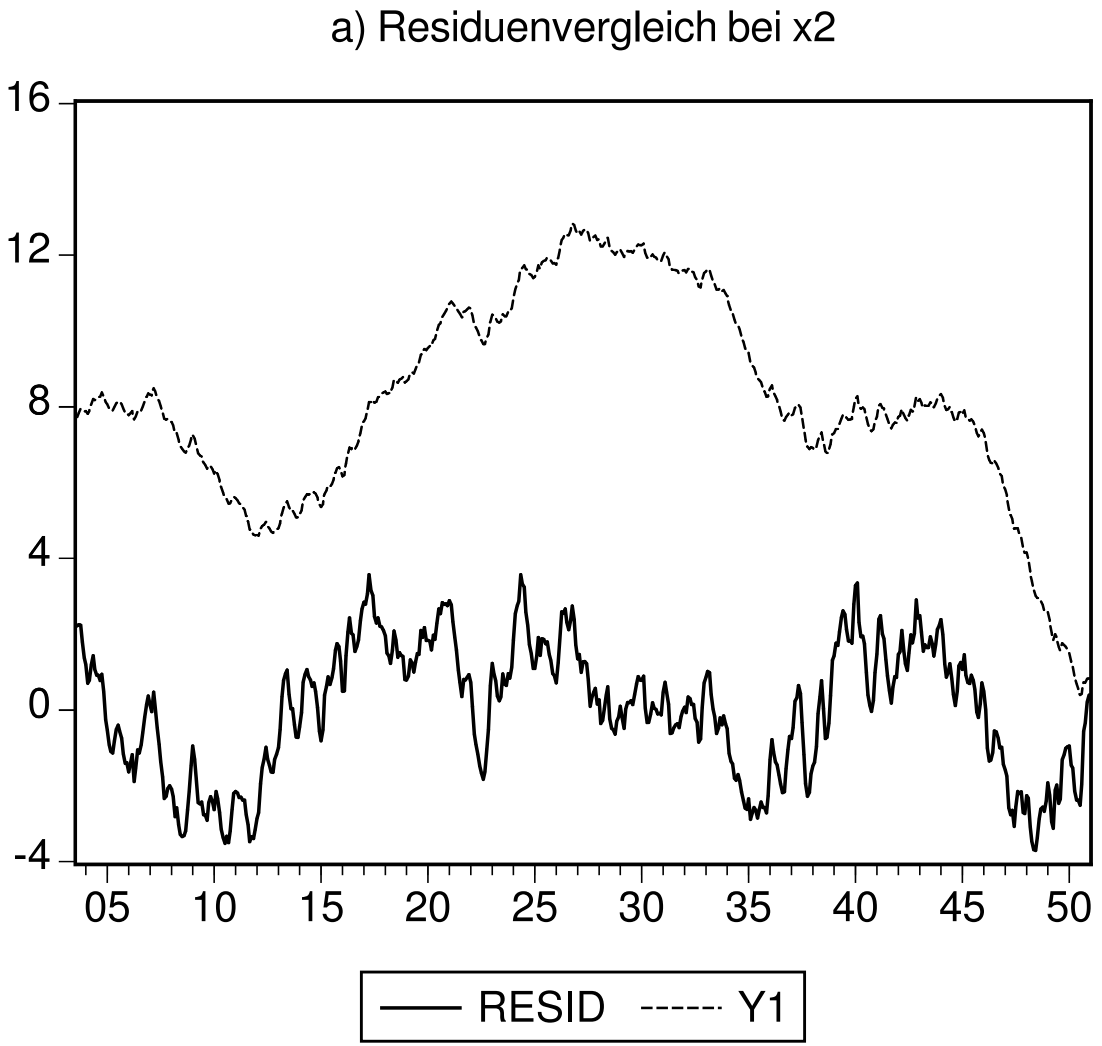
8
4
0
-4
-8
40
30
20
10
0
05
10
15
20
25
30
35
40
45
50
Residual
Actual
Fitted

a) Regression für x2

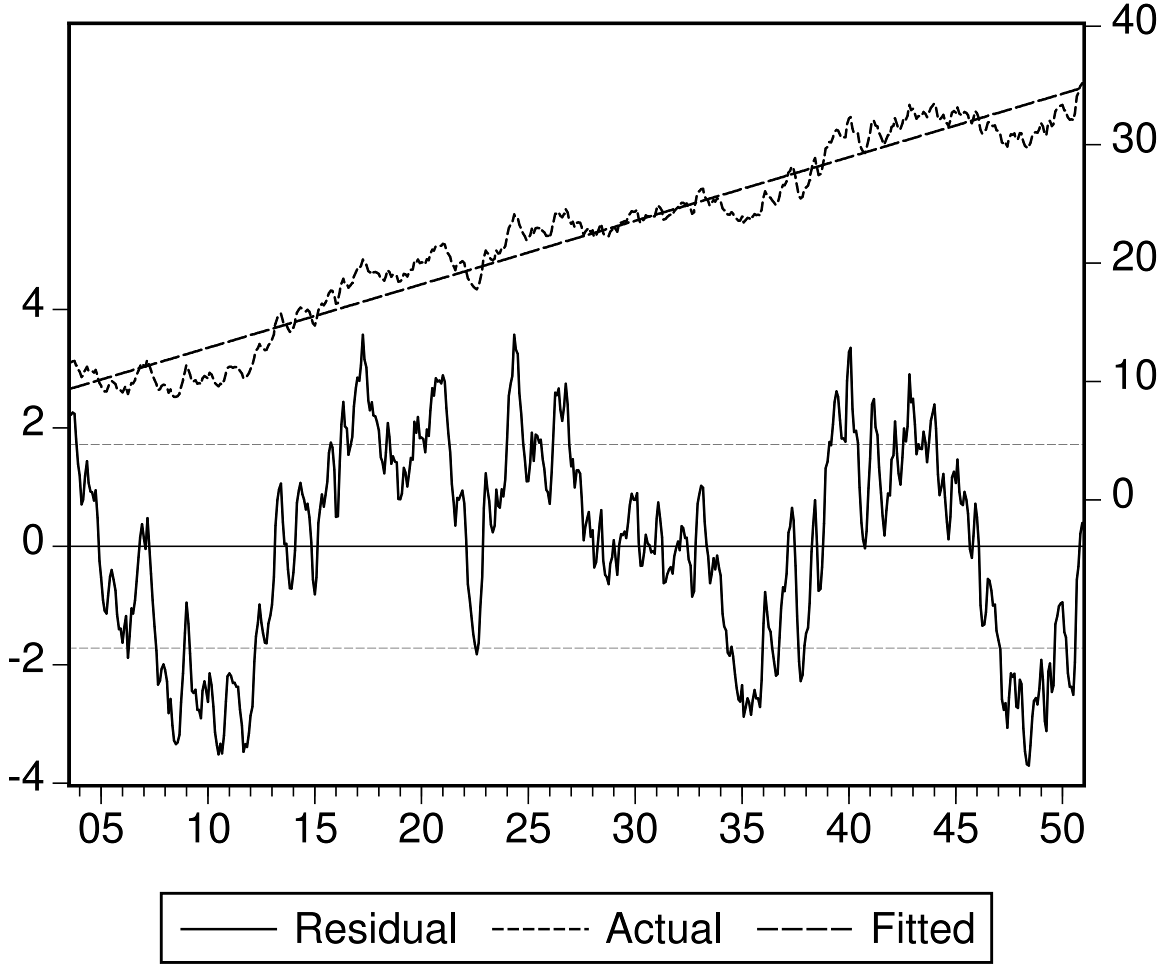
Dependent Variable: X2
Method: Least Squares
Date: 06/29/07 Time: 09:41
Sample: 2003M08 2050M12
Included observations: 569

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	9.405976	0.143957	65.33889	0.0000
@TREND	0.044681	0.000439	101.8283	0.0000

R-squared	0.948153	Mean dependent var	22.09535
Adjusted R-squared	0.948061	S.D. dependent var	7.543719
S.E. of regression	1.719216	Akaike info criterion	3.925123
Sum squared resid	1675.884	Schwarz criterion	3.940391
Log likelihood	-1114.697	F-statistic	10369.00
Durbin-Watson stat	0.048929	Prob(F-statistic)	0.000000


a) Residuenvergleich bei x2
16
12
8
4
0
-4
05
10
15
20
25
30
35
40
45
50
RESID
Y1

a) Residuen von x2

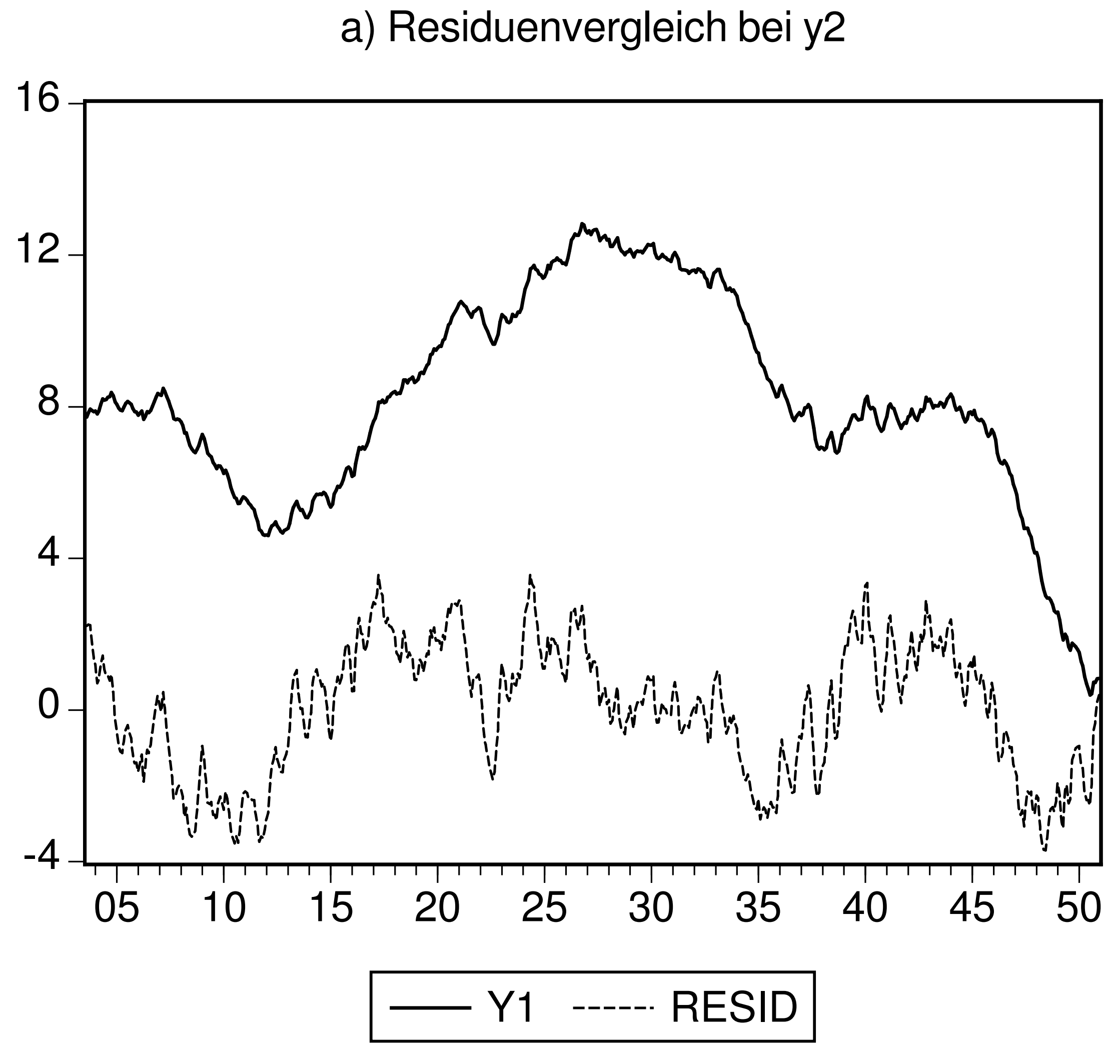


a) Regression mit y2

Dependent Variable: Y2
Method: Least Squares
Date: 06/29/07 Time: 09:47
Sample: 2003M08 2050M12
Included observations: 569

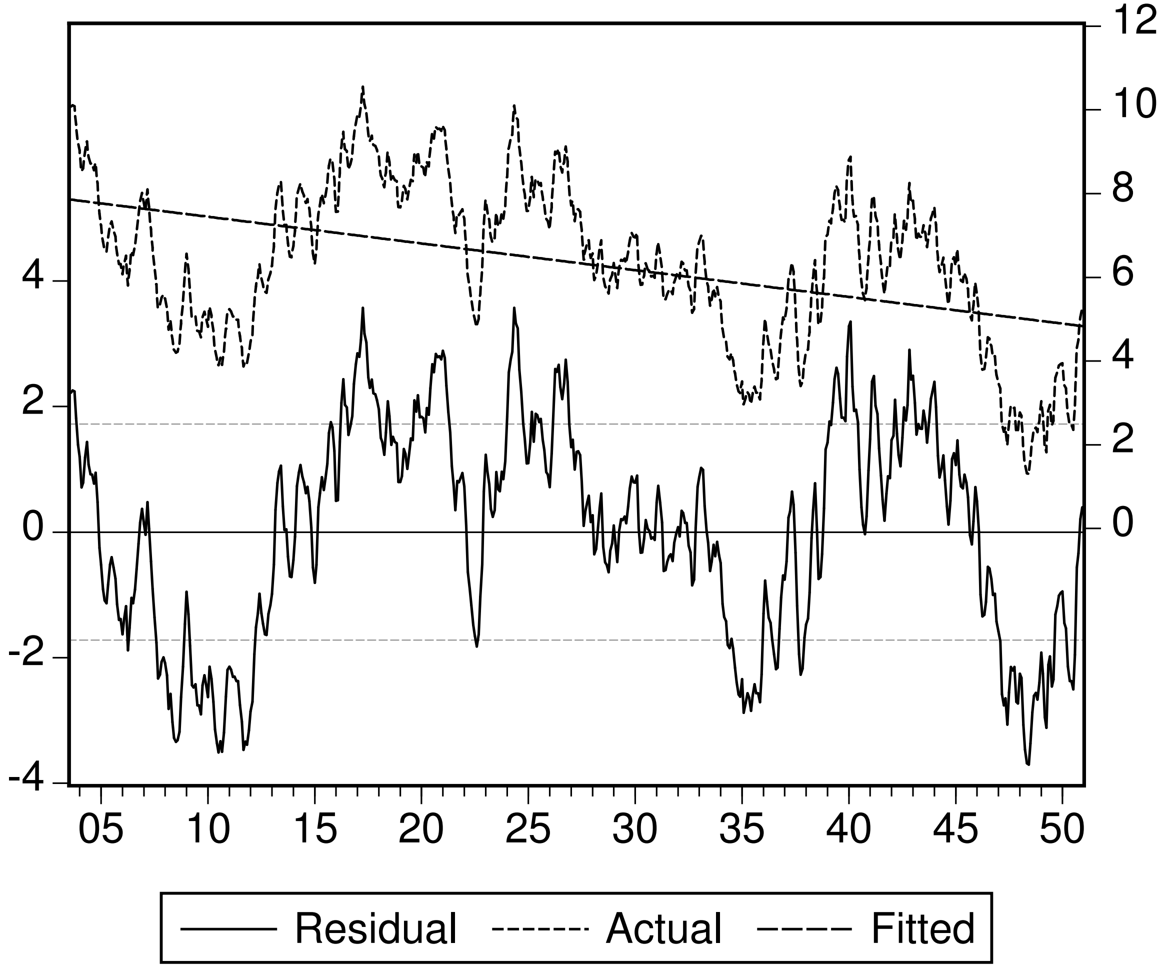
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.855976	0.143957	54.57177	0.0000
@TREND	-0.005319	0.000439	-12.12233	0.0000

R-squared	0.205828	Mean dependent var	6.345347
Adjusted R-squared	0.204427	S.D. dependent var	1.927483
S.E. of regression	1.719216	Akaike info criterion	3.925123
Sum squared resid	1675.884	Schwarz criterion	3.940391
Log likelihood	-1114.697	F-statistic	146.9509
Durbin-Watson stat	0.048929	Prob(F-statistic)	0.000000



a) Residuenvergleich bei y2
16
12
8
4
0
-4
05
10
15
20
25
30
35
40
45
50
Y1
RESID

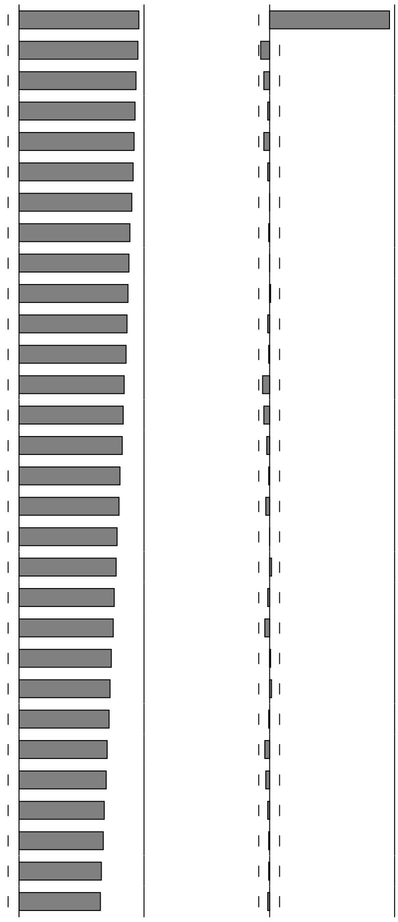
a) Residuen bei y2



a) Correlogram of Y1

Date: 07/03/07 Time: 11:00
Sample: 2003M08 2050M12
Included observations: 569

Autocorrelation | Partial Correlation

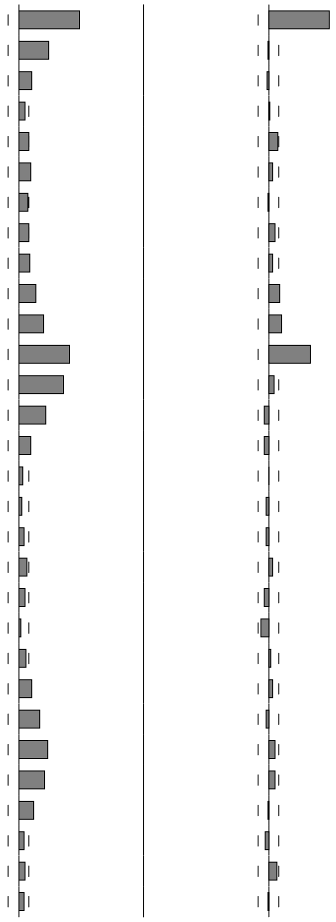


	AC	PAC	Q-Stat	Prob
1	0.993	0.993	563.58	0.000
2	0.984	-0.073	1118.6	0.000
3	0.975	-0.046	1664.4	0.000
4	0.966	-0.015	2200.8	0.000
5	0.956	-0.047	2727.1	0.000
6	0.946	-0.016	3243.1	0.000
7	0.935	0.005	3748.9	0.000
8	0.925	-0.000	4244.8	0.000
9	0.915	0.006	4730.9	0.000
10	0.906	0.015	5207.7	0.000
11	0.896	-0.016	5675.1	0.000
12	0.886	-0.008	6133.1	0.000
13	0.876	-0.054	6581.3	0.000
14	0.865	-0.045	7018.8	0.000
15	0.853	-0.024	7445.6	0.000
16	0.841	-0.008	7861.6	0.000
17	0.829	-0.029	8266.3	0.000
18	0.817	0.008	8660.2	0.000
19	0.806	0.020	9043.6	0.000
20	0.794	-0.012	9416.5	0.000
21	0.782	-0.035	9778.8	0.000
22	0.770	0.012	10131.	0.000
23	0.759	0.019	10473.	0.000
24	0.747	-0.003	10806.	0.000
25	0.736	-0.034	11129.	0.000
26	0.724	-0.031	11442.	0.000
27	0.711	-0.013	11746.	0.000
28	0.699	-0.007	12039.	0.000
29	0.687	-0.001	12323.	0.000
30	0.674	-0.012	12597.	0.000

a) Correlogram of D(Y1)

Date: 07/03/07 Time: 11:01
Sample: 2003M08 2050M12
Included observations: 568

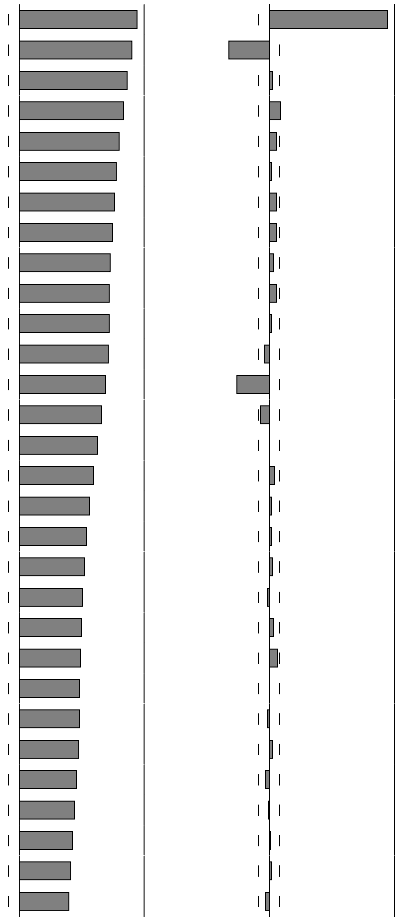
Autocorrelation | Partial Correlation



	AC	PAC	Q-Stat	Prob
1	0.501	0.501	143.57	0.000
2	0.249	-0.004	178.90	0.000
3	0.111	-0.016	186.01	0.000
4	0.056	0.010	187.83	0.000
5	0.086	0.077	192.10	0.000
6	0.098	0.035	197.68	0.000
7	0.074	-0.005	200.84	0.000
8	0.086	0.052	205.14	0.000
9	0.093	0.038	210.11	0.000
10	0.144	0.097	222.21	0.000
11	0.206	0.112	246.90	0.000
12	0.419	0.347	348.90	0.000
13	0.376	0.044	431.31	0.000
14	0.229	-0.041	462.07	0.000
15	0.103	-0.033	468.27	0.000
16	0.040	0.001	469.21	0.000
17	0.032	-0.019	469.83	0.000
18	0.045	-0.023	471.03	0.000
19	0.069	0.037	473.83	0.000
20	0.053	-0.036	475.51	0.000
21	0.021	-0.058	475.78	0.000
22	0.061	0.017	478.01	0.000
23	0.109	0.037	485.07	0.000
24	0.178	-0.020	503.89	0.000
25	0.242	0.052	538.94	0.000
26	0.219	0.050	567.52	0.000
27	0.128	-0.007	577.37	0.000
28	0.044	-0.032	578.54	0.000
29	0.054	0.072	580.31	0.000
30	0.041	-0.004	581.33	0.000

a) Correlogram of Y2

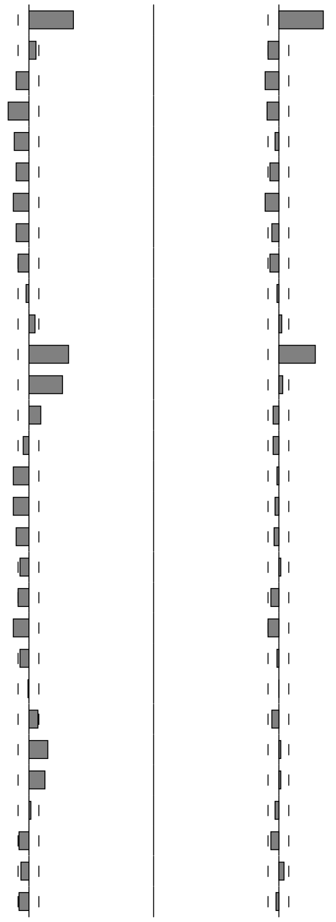
Date: 07/03/07 Time: 11:03
Sample: 2003M08 2050M12
Included observations: 569



Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.977	0.977	545.96	0.000
		2	0.939	-0.335	1051.5	0.000
		3	0.899	0.026	1515.1	0.000
		4	0.863	0.097	1943.3	0.000
		5	0.833	0.062	2343.5	0.000
		6	0.809	0.018	2720.9	0.000
		7	0.789	0.065	3080.6	0.000
		8	0.774	0.065	3427.2	0.000
		9	0.762	0.035	3764.0	0.000
		10	0.753	0.061	4093.9	0.000
		11	0.747	0.023	4418.5	0.000
		12	0.738	-0.033	4736.3	0.000
		13	0.717	-0.269	5036.5	0.000
		14	0.685	-0.069	5311.1	0.000
		15	0.649	0.005	5557.8	0.000
		16	0.615	0.045	5779.9	0.000
		17	0.587	0.017	5982.5	0.000
		18	0.564	0.019	6170.0	0.000
		19	0.546	0.032	6346.2	0.000
		20	0.531	-0.015	6513.4	0.000
		21	0.520	0.033	6673.6	0.000
		22	0.513	0.072	6829.6	0.000
		23	0.508	0.007	6983.0	0.000
		24	0.503	-0.012	7134.0	0.000
		25	0.496	0.025	7280.6	0.000
		26	0.482	-0.026	7419.5	0.000
		27	0.463	-0.001	7548.2	0.000
		28	0.445	0.014	7666.9	0.000
		29	0.429	0.022	7777.4	0.000
		30	0.415	-0.031	7881.3	0.000

a) Correlogram of D(Y2)

Date: 07/03/07 Time: 11:06
Sample: 2003M08 2050M12
Included observations: 568



Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.374	0.374	79.892	0.000
		2	0.063	-0.089	82.176	0.000
		3	-0.102	-0.110	88.106	0.000
		4	-0.165	-0.096	103.79	0.000
		5	-0.121	-0.026	112.18	0.000
		6	-0.101	-0.066	118.00	0.000
		7	-0.125	-0.110	127.09	0.000
		8	-0.103	-0.057	133.25	0.000
		9	-0.090	-0.071	137.91	0.000
		10	-0.023	-0.009	138.23	0.000
		11	0.057	0.025	140.10	0.000
		12	0.329	0.309	202.96	0.000
		13	0.280	0.040	248.60	0.000
		14	0.104	-0.042	254.89	0.000
		15	-0.049	-0.042	256.30	0.000
		16	-0.124	-0.012	265.34	0.000
		17	-0.127	-0.032	274.89	0.000
		18	-0.106	-0.040	281.51	0.000
		19	-0.072	0.019	284.57	0.000
		20	-0.089	-0.058	289.26	0.000
		21	-0.125	-0.089	298.49	0.000
		22	-0.069	-0.016	301.35	0.000
		23	-0.007	0.006	301.38	0.000
		24	0.080	-0.056	305.23	0.000
		25	0.163	0.019	321.12	0.000
		26	0.135	0.023	332.03	0.000
		27	0.024	-0.032	332.38	0.000
		28	-0.077	-0.059	335.97	0.000
		29	-0.062	0.047	338.28	0.000
		30	-0.074	-0.022	341.58	0.000

Augmented Dickey-Fuller Unit Root Test on Y1

Null Hypothesis: Y1 has a unit root
Exogenous: Constant
Lag Length: 12 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.920453	0.7816
Test critical values:	1% level	-3.441882	
	5% level	-2.866519	
	10% level	-2.569482	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(Y1)
Method: Least Squares
Date: 07/03/07 Time: 11:15
Sample (adjusted): 2004M09 2050M12
Included observations: 556 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Y1(-1)	-0.001546	0.001680	-0.920453	0.3577
D(Y1(-1))	0.442916	0.040113	11.04159	0.0000
D(Y1(-2))	-0.003184	0.044360	-0.071775	0.9428
D(Y1(-3))	-0.023253	0.044385	-0.523896	0.6006
D(Y1(-4))	-0.043387	0.044797	-0.968527	0.3332
D(Y1(-5))	0.062962	0.044767	1.406433	0.1602
D(Y1(-6))	0.021958	0.044868	0.489395	0.6248
D(Y1(-7))	-0.048031	0.044815	-1.071765	0.2843
D(Y1(-8))	0.049756	0.044755	1.111740	0.2667
D(Y1(-9))	0.005883	0.044867	0.131117	0.8957
D(Y1(-10))	0.041672	0.044854	0.929056	0.3533
D(Y1(-11))	-0.056587	0.044937	-1.259242	0.2085
D(Y1(-12))	0.366064	0.040827	8.966282	0.0000
C	0.009347	0.014795	0.631733	0.5278

R-squared	0.370922	Mean dependent var	-0.013344
Adjusted R-squared	0.355834	S.D. dependent var	0.122415
S.E. of regression	0.098250	Akaike info criterion	-1.777736
Sum squared resid	5.232012	Schwarz criterion	-1.668939
Log likelihood	508.2105	F-statistic	24.58300
Durbin-Watson stat	2.035984	Prob(F-statistic)	0.000000

a) Dickey Fuller per Hand

Dependent Variable: D(Y1)
Method: Least Squares
Date: 08/05/07 Time: 15:11
Sample (adjusted): 2004M09 2050M12
Included observations: 556 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.009347	0.014795	0.631733	0.5278
Y1(-1)	-0.001546	0.001680	-0.920453	0.3577
D(Y1(-1))	0.442916	0.040113	11.04159	0.0000
D(Y1(-2))	-0.003184	0.044360	-0.071775	0.9428
D(Y1(-3))	-0.023253	0.044385	-0.523896	0.6006
D(Y1(-4))	-0.043387	0.044797	-0.968527	0.3332
D(Y1(-5))	0.062962	0.044767	1.406433	0.1602
D(Y1(-6))	0.021958	0.044868	0.489395	0.6248
D(Y1(-7))	-0.048031	0.044815	-1.071765	0.2843
D(Y1(-8))	0.049756	0.044755	1.111740	0.2667
D(Y1(-9))	0.005883	0.044867	0.131117	0.8957
D(Y1(-10))	0.041672	0.044854	0.929056	0.3533
D(Y1(-11))	-0.056587	0.044937	-1.259242	0.2085
D(Y1(-12))	0.366064	0.040827	8.966282	0.0000

R-squared	0.370922	Mean dependent var	-0.013344
Adjusted R-squared	0.355834	S.D. dependent var	0.122415
S.E. of regression	0.098250	Akaike info criterion	-1.777736
Sum squared resid	5.232012	Schwarz criterion	-1.668939
Log likelihood	508.2105	F-statistic	24.58300
Durbin-Watson stat	2.035984	Prob(F-statistic)	0.000000

a) Dickey Fuller (per Hand) nur mit signifikanten Lags

Dependent Variable: D(Y1)
Method: Least Squares
Date: 07/03/07 Time: 11:28
Sample (adjusted): 2004M09 2050M12
Included observations: 556 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.005959	0.013643	0.436759	0.6625
Y1(-1)	-0.001186	0.001568	-0.756557	0.4496
D(Y1(-1))	0.433530	0.035057	12.36648	0.0000
D(Y1(-12))	0.348258	0.035922	9.694794	0.0000

R-squared	0.362093	Mean dependent var	-0.013344
Adjusted R-squared	0.358626	S.D. dependent var	0.122415
S.E. of regression	0.098037	Akaike info criterion	-1.799769
Sum squared resid	5.305446	Schwarz criterion	-1.768684
Log likelihood	504.3357	F-statistic	104.4433
Durbin-Watson stat	2.018569	Prob(F-statistic)	0.000000

a) Correlogram of Residuals

Date: 07/03/07 Time: 11:32
Sample: 2004M09 2050M12
Included observations: 556

	AC	PAC	Q-Stat	Prob
1	-0.009	-0.009	0.0503	0.823
2	0.002	0.002	0.0526	0.974
3	-0.014	-0.014	0.1565	0.984
4	-0.043	-0.043	1.1790	0.882
5	0.047	0.046	2.4257	0.788
6	0.039	0.040	3.2796	0.773
7	-0.037	-0.038	4.0554	0.773
8	0.051	0.050	5.5515	0.697
9	0.037	0.044	6.3402	0.705
10	0.049	0.049	7.6826	0.660
11	-0.038	-0.044	8.5172	0.666
12	-0.022	-0.015	8.7841	0.721
13	0.030	0.034	9.3108	0.749
14	-0.019	-0.025	9.5092	0.797
15	-0.030	-0.040	10.018	0.819
16	-0.014	-0.015	10.126	0.860
17	-0.033	-0.026	10.757	0.869
18	-0.013	-0.028	10.855	0.900
19	0.011	0.006	10.930	0.926
20	-0.017	-0.008	11.090	0.944
21	-0.059	-0.059	13.136	0.904
22	-0.032	-0.035	13.735	0.911
23	0.013	0.019	13.841	0.931
24	-0.033	-0.029	14.492	0.935
25	0.031	0.030	15.051	0.940
26	0.053	0.062	16.698	0.918
27	0.007	0.019	16.726	0.938
28	-0.060	-0.066	18.810	0.904
29	0.048	0.056	20.169	0.888
30	-0.043	-0.024	21.251	0.880
31	0.065	0.059	23.770	0.820
32	0.089	0.083	28.486	0.645
33	-0.036	-0.030	29.251	0.654
34	0.051	0.049	30.811	0.625
35	0.015	0.007	30.953	0.664
36	0.025	0.028	31.336	0.690

a) Dickey Fuller Test (per Hand)

Dependent Variable: D(Y2)
Method: Least Squares
Date: 07/03/07 Time: 11:37
Sample (adjusted): 2004M09 2050M12
Included observations: 556 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.187720	0.048534	3.867795	0.0001
Y2(-1)	-0.029908	0.007392	-4.046258	0.0001
D(Y2(-1))	0.369343	0.036806	10.03478	0.0000
D(Y2(-12))	0.324033	0.037178	8.715785	0.0000

R-squared	0.261658	Mean dependent var	-0.006254
Adjusted R-squared	0.257645	S.D. dependent var	0.381972
S.E. of regression	0.329107	Akaike info criterion	0.622302
Sum squared resid	59.78798	Schwarz criterion	0.653387
Log likelihood	-168.9999	F-statistic	65.20691
Durbin-Watson stat	2.009718	Prob(F-statistic)	0.000000

a) Dickey Fuller Test (per Hand)

Dependent Variable: D(X2)
Method: Least Squares
Date: 07/03/07 Time: 11:46
Sample (adjusted): 2004M09 2050M12
Included observations: 556 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.344297	0.080419	4.281260	0.0000
@TREND	0.001631	0.000377	4.329023	0.0000
X2(-1)	-0.036009	0.008149	-4.418706	0.0000
D(X2(-1))	0.372852	0.036790	10.13456	0.0000
D(X2(-12))	0.325221	0.037113	8.762976	0.0000

R-squared	0.265797	Mean dependent var	0.043746
Adjusted R-squared	0.260467	S.D. dependent var	0.381972
S.E. of regression	0.328481	Akaike info criterion	0.620277
Sum squared resid	59.45282	Schwarz criterion	0.659133
Log likelihood	-167.4371	F-statistic	49.86836
Durbin-Watson stat	2.015514	Prob(F-statistic)	0.000000

Goethe-Universität Frankfurt

Statistik und Methoden der Ökonometrie

Prof. Dr. Uwe Hassler

Finanzökonometrie Sommersemester 2007

11. Übung: Ehemalige Klausuraufgaben

1) Es stehe r für eine Reihe werktäglicher Renditen vom 6. April 1999 bis zum 28. März 2003 ($T = 1039$).

(a) Die Koeffizienten von Schiefe und Kurtosis betragen $\widehat{\gamma}_1 = 0.221$ und $\widehat{\gamma}_2 = 4.183$. Testen Sie die Nullhypothese, dass die Daten normalverteilt sind.

(b) Den Daten wurden zwei GARCH-Modelle angepasst, basierend auf $r_t = h_t \varepsilon_t$:

$$GARCH(2,1): \quad h_t^2 = 0.0059 + \underset{(0.025)}{0.058} r_{t-1}^2 + \underset{(0.343)}{1.178} h_{t-1}^2 - \underset{(0.310)}{0.266} h_{t-2}^2 \,,$$

$$GARCH(1,1): \quad h_t^2 = 0.007 + \underset{(0.017)}{0.075} r_{t-1}^2 + \underset{(0.027)}{0.884} h_{t-1}^2 \,.$$

Welches würden Sie (Warum?) vorziehen?

2) Es bezeichne p monatlich beobachtete Inflationsraten von 1960.01 bis 2004.12.

(a) Die Zeitreihe soll mit dem Dickey-Fuller-Test auf eine Einheitswurzel getestet werden. Dazu wurde einmal mit und einmal ohne linearen Zeittrend regressiert:

$$\Delta p_t = 0.064 - \underset{(0.0021)}{0.002}\, p_{t-1} + \underset{(0.0399)}{0.380}\, \Delta p_{t-1} + \widehat{\varepsilon}_t \,,$$

$$\Delta p_t = 0.329 + \underset{(0.0004)}{0.001}\, t - \underset{(0.0088)}{0.033}\, p_{t-1} + \underset{(0.0398)}{0.399}\, \Delta p_{t-1} + \widehat{\varepsilon}_t \,.$$

Wie entscheiden Sie sich? (Kurze Begründung.)

(b) Der Zeitreihe wurde ein AR(13)-Modell angepasst. Testen Sie, ob die Residuen $\widehat{u}_t$ frei von ARCH-Effekten sind:

$$\widehat{u}_t^2 = 0.115 - \underset{(0.044)}{0.025}\, \widehat{u}_{t-1}^2 + \underset{(0.041)}{0.050}\, \widehat{u}_{t-2}^2 + \widehat{\varepsilon}_t \,, \quad \text{mit } R^2 = 0.0056 \,.$$

3) Es liegen monatliche Beobachtungen für den logarithmierten Wechselkurs x zweier Währungen und Preisindices des Inlandes, P^i, und des Auslandes, P^a, vor (1960.01 bis 2004.12).

Im folgenden bezeichnet sp die Differenz (den "spread") des logarithmierten Preisniveaus, $sp := \log(P^i) - \log(P^a)$. (Mit den Daten soll die Kaufkraftparitätenhypothese überprüft werden.)

Unterstellen Sie für das folgende, dass sp und x integriert der Ordnung 1 sind (ohne Drift).

(a) Betrachten Sie die statische Regression von x auf sp,

$$x_t = 3.99 + 0.979\, sp_t + res_t\,, \quad \text{mit } dw = 1.100 \text{ und } R^2 = 0.975\,.$$

(i) Was sagen Ihnen die angegebenen Werte des Bestimmtheitsmaßes und der Durbin-Watson-Statistik im Hinblick auf mögliche Kointegration?

(ii) Mit den Residuen res erhält man

$$\Delta res_t = \widehat{\phi}\; res_{t-1} + 0.37 \Delta res_{t-1} + 0.23 \Delta res_{t-12} + \widehat{\varepsilon}_t$$

mit $\widehat{\phi} = -0.09$ und der t-Statistik

$$t_{res,\mu} = \frac{-0.09}{s.e.} = -3.85\,.$$

Was können Sie damit zur Kointegration von x und sp sagen?

(b) Betrachten Sie nun die Fehlerkorrekturgleichung

$$\Delta x_t = 4.12 - 0.891 x_{t-1} + 0.813 sp_{t-1} + 0.537 \Delta sp_{t-1} + 0.682 \Delta x_{t-1} + \widehat{\varepsilon}_t\,.$$

Schätzen Sie den Kointegrationsparameter aus der Fehlerkorrekturgleichung.

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Finanzökonometrie Sommersemester 2007

Musterlösung zur 11. Übung

1) (a) Es gibt drei korrekte Lösungswege.

i) $H_0^{(1)} : \gamma_1 = 0 \quad \text{mit} \quad \Gamma_1 = \sqrt{T}\frac{\widehat{\gamma}_1}{\sqrt{6}} = 2.908.$

Ablehnen zum Niveau $\alpha = 0.004$ mit $N(0,1)$, weil $|\Gamma_1| > z_{0.998} = 2.8782$.

ii) $H_0^{(2)} : \gamma_2 = 3 \quad \text{mit} \quad \Gamma_2 = \sqrt{T}\frac{(\widehat{\gamma}_2 - 3)}{\sqrt{24}} = 7.784.$

Ablehnen mit $N(0,1)$, weil $|\Gamma_2| > z_{0.999} = 3.0902$.

iii) $H_0 : \gamma_1 = 0 \quad \text{und} \quad \gamma_2 = 3 \quad \text{mit} \quad \Gamma_1^2 + \Gamma_2^2 = 69.05.$

Ablehnen mit $\chi^2(2)$ zum Niveau $\alpha = 0.005$, weil $69.05 > \chi^2_{0.995}(2)$.

(b) Ich würde GARCH(1,1) vorziehen, weil der Koeffizient bei h_{t-2}^2 zu keinem vernünftigen Niveau signifikant von Null verschieden ist und weil es ein Vorzeichen hat, welches die hinreichende Bedingung für $h_t^2 > 0$ verletzt.

2) Es liegen Monatsdaten aus 45 Jahren vor, $T = 540$.

(a) Im Modell 2 gilt mit $t_{\rho,\mu} = -0.952$, dass die Nullhypothese "$I(1)$ ohne Drift" zu keinem vernünftigen Niveau abgelehnt werden kann. Im Modell 1 gilt mit $t_{\rho,\tau} = -3.75$, dass "$I(1)$ mit Drift" zum Niveau 5% abgelehnt werden kann. Die Nichtablehnung im Modell 2 rührt wohl vom linearen Trend her. Daher entscheide ich mich zum 5% - Niveau gegen eine Einheitswurzel. (Genauso korrekt: Zum 1% - Niveau die Hypothese einer Einheitswurzel nicht ablehnen).

(b) ARCH-LM-Test (mit 2 Freiheitsgraden): $TR^2 = 3.024 < 4.605 = \chi^2_{0.9}(2)$.
H_0: keine ARCH Effekte. Wird zum 10% - Niveau nicht abgelehnt.

3) Wieder ergeben 45 Jahre monatlicher Beobachtungen $T = 540$.

(a) (i) dw ist deutlich von Null verschieden, R^2 ist nahe Eins. Vor dem Hintergrund der Sätze 5.3 und 5.4 spricht dies für Kointegration.

(ii) Korrekte Quantile stammen aus der Verteilung $\mathcal{DF}_\mu(1)$. $t_{res,\mu}$ ist also signifikant zu 5%, aber nicht zu 1%. H_0 "keine Kointegration" kann zum 5% - Niveau abgelehnt werden.

(b) Als KI-Schätzer aus FK-Gleichung erhält man

$$\widehat{b}_{EC} = -\frac{\widehat{\theta}}{\widehat{\gamma}} = -\frac{0.813}{-0.891} = 0.912.$$

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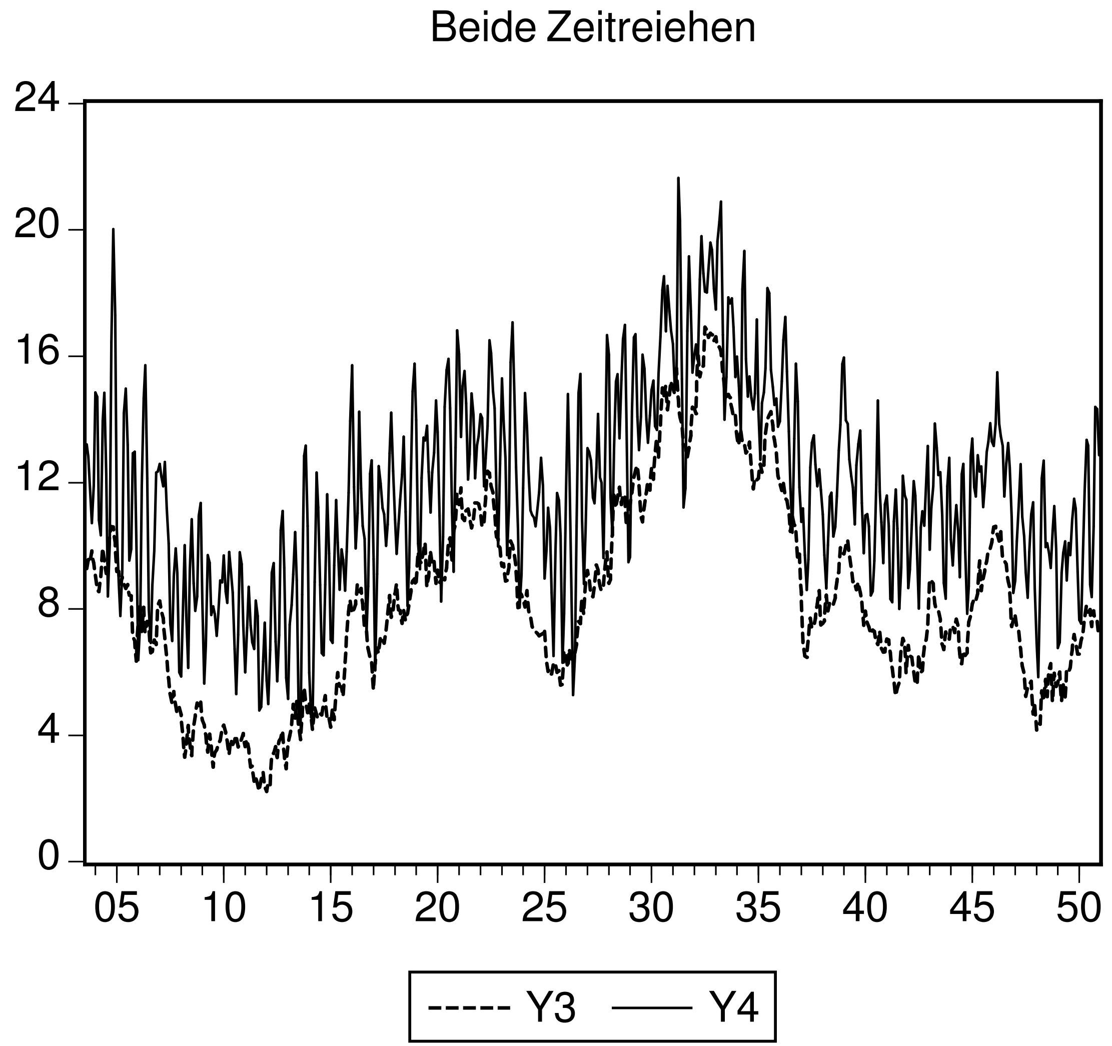
12. Übung: Kointegrationsanalyse

Laden Sie die EVIEWS-Datei *unitroot* mit simulierten monatlichen Beobachtungen von 2003.08 bis 2050.12.

Testen und analysieren Sie, ob $y4$ und $y3$ kointegriert sind. Schätzen Sie für den Fall von Kointegration den Kointegrationsparameter. Welche der Variablen passt sich (wie stark) an vergangene Gleichgewichtsabweichungen an?


Beide Zeitreihen
24
20
16
12
8
4
0
05
10
15
20
25
30
35
40
45
50
Y3
Y4

1. Möglichkeit der Abhängigkeit

Dependent Variable: Y3
Method: Least Squares
Date: 07/19/07 Time: 12:00
Sample: 2003M08 2050M12
Included observations: 569

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.190558	0.291371	-4.086054	0.0001
Y4	0.808586	0.023915	33.81069	0.0000

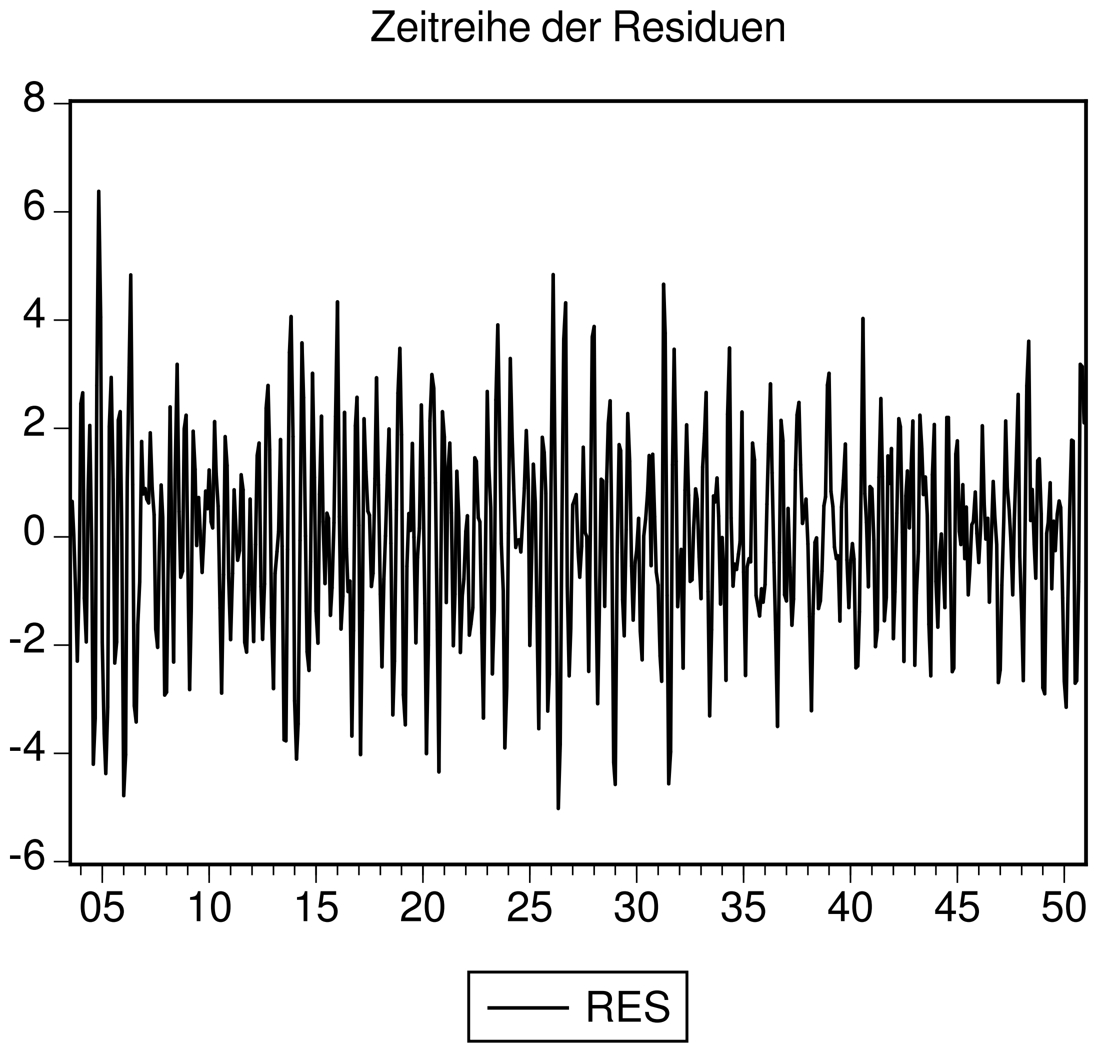
R-squared	0.668453	Mean dependent var	8.313369
Adjusted R-squared	0.667868	S.D. dependent var	3.175002
S.E. of regression	1.829783	Akaike info criterion	4.049780
Sum squared resid	1898.375	Schwarz criterion	4.065049
Log likelihood	-1150.162	F-statistic	1143.163
Durbin-Watson stat	0.807888	Prob(F-statistic)	0.000000

2. Möglichkeit der Abhängigkeit

Dependent Variable: Y4
Method: Least Squares
Date: 07/19/07 Time: 12:01
Sample: 2003M08 2050M12
Included observations: 569

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.881157	0.217563	22.43562	0.0000
Y3	0.826694	0.024451	33.81069	0.0000

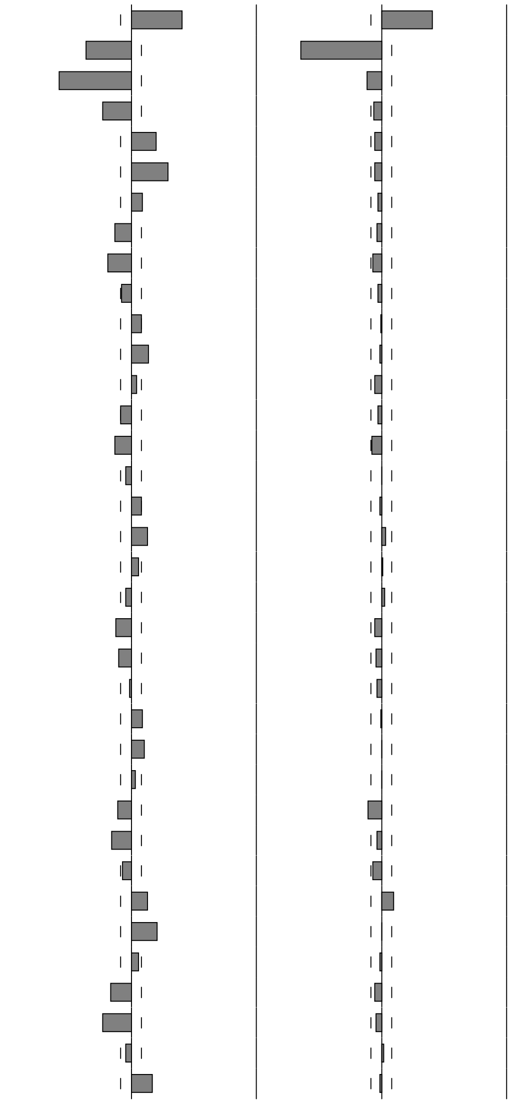
R-squared	0.668453	Mean dependent var	11.75377
Adjusted R-squared	0.667868	S.D. dependent var	3.210357
S.E. of regression	1.850158	Akaike info criterion	4.071928
Sum squared resid	1940.888	Schwarz criterion	4.087196
Log likelihood	-1156.463	F-statistic	1143.163
Durbin-Watson stat	1.156675	Prob(F-statistic)	0.000000


Zeitreihe der Residuen
8
6
4
2
0
-2
-4
-6
05
10
15
20
25
30
35
40
45
50
RES

Correlogram of RES

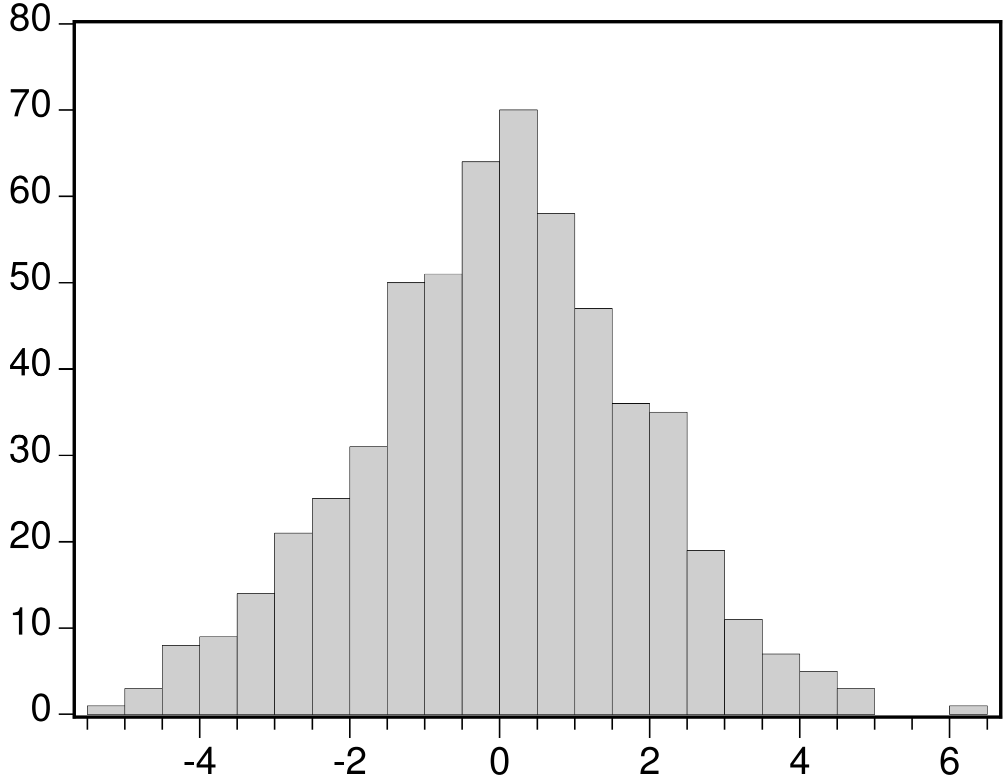
Date: 07/19/07 Time: 12:05
Sample: 2003M08 2050M12
Included observations: 569

Autocorrelation | Partial Correlation



#	AC	PAC	Q-Stat	Prob
1	0.420	0.420	101.10	0.000
2	-0.374	-0.669	181.13	0.000
3	-0.598	-0.120	386.46	0.000
4	-0.232	-0.064	417.49	0.000
5	0.207	-0.057	442.25	0.000
6	0.306	-0.049	496.38	0.000
7	0.097	-0.026	501.85	0.000
8	-0.134	-0.039	512.31	0.000
9	-0.196	-0.073	534.65	0.000
10	-0.080	-0.032	538.38	0.000
11	0.083	-0.001	542.35	0.000
12	0.140	-0.011	553.86	0.000
13	0.043	-0.055	554.93	0.000
14	-0.087	-0.029	559.35	0.000
15	-0.135	-0.078	569.96	0.000
16	-0.041	0.001	570.96	0.000
17	0.089	-0.009	575.65	0.000
18	0.139	0.034	586.98	0.000
19	0.064	0.012	589.38	0.000
20	-0.049	0.026	590.79	0.000
21	-0.124	-0.054	599.94	0.000
22	-0.106	-0.044	606.58	0.000
23	-0.010	-0.036	606.64	0.000
24	0.090	-0.005	611.51	0.000
25	0.111	0.003	618.86	0.000
26	0.037	0.003	619.68	0.000
27	-0.107	-0.109	626.58	0.000
28	-0.158	-0.038	641.59	0.000
29	-0.067	-0.068	644.26	0.000
30	0.138	0.103	655.75	0.000
31	0.217	0.000	684.28	0.000
32	0.065	-0.015	686.85	0.000
33	-0.169	-0.056	704.12	0.000
34	-0.231	-0.046	736.55	0.000
35	-0.042	0.018	737.63	0.000
36	0.178	-0.010	757.02	0.000

Histogramm der Residuen



Series: RES
Sample 2003M08 2050M12
Observations 569

Mean	-2.49e-15
Median	0.050366
Maximum	6.378442
Minimum	-5.014467
Std. Dev.	1.848528
Skewness	-0.054454
Kurtosis	2.992987
Jarque-Bera	0.282370
Probability	0.868329

Residuenregression zur Bestimmung der Lags

Dependent Variable: D(RES)
Method: Least Squares
Date: 07/19/07 Time: 12:08
Sample (adjusted): 2004M01 2050M12
Included observations: 564 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RES(-1)	-1.236366	0.085921	-14.38963	0.0000
D(RES(-1))	0.839792	0.070534	11.90617	0.0000
D(RES(-2))	0.212225	0.062384	3.401920	0.0007
D(RES(-3))	0.092426	0.045512	2.030808	0.0427
D(RES(-4))	0.057309	0.042422	1.350945	0.1773

R-squared	0.617451	Mean dependent var	0.005123
Adjusted R-squared	0.614713	S.D. dependent var	1.994471
S.E. of regression	1.237998	Akaike info criterion	3.273693
Sum squared resid	856.7447	Schwarz criterion	3.312125
Log likelihood	-918.1815	Durbin-Watson stat	1.999287

neue Residuenregression (ohne nicht sign. Lags)

Dependent Variable: D(RES)
Method: Least Squares
Date: 07/19/07 Time: 12:14
Sample (adjusted): 2003M12 2050M12
Included observations: 565 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RES(-1)	-1.169440	0.070125	-16.67639	0.0000
D(RES(-1))	0.776860	0.052948	14.67209	0.0000
D(RES(-2))	0.153932	0.045030	3.418449	0.0007
D(RES(-3))	0.069805	0.042311	1.649794	0.0995

R-squared	0.616590	Mean dependent var	0.007790
Adjusted R-squared	0.614539	S.D. dependent var	1.993710
S.E. of regression	1.237805	Akaike info criterion	3.271610
Sum squared resid	859.5418	Schwarz criterion	3.302313
Log likelihood	-920.2299	Durbin-Watson stat	2.003627

Correlogram of Residuals

Date: 07/19/07 Time: 12:15
Sample: 2003M12 2050M12
Included observations: 565

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	-0.004	-0.004	0.0090	0.925
		2	-0.008	-0.008	0.0458	0.977
		3	-0.044	-0.044	1.1259	0.771
		4	-0.024	-0.024	1.4430	0.837
		5	-0.036	-0.037	2.1879	0.823
		6	-0.066	-0.069	4.6583	0.588
		7	-0.058	-0.063	6.6052	0.471
		8	-0.005	-0.011	6.6173	0.578
		9	-0.010	-0.019	6.6700	0.671
		10	-0.027	-0.039	7.1027	0.716
		11	-0.028	-0.039	7.5560	0.752
		12	0.022	0.009	7.8399	0.798
		13	-0.031	-0.045	8.3886	0.817
		14	0.010	-0.002	8.4525	0.864
		15	-0.036	-0.044	9.2152	0.866
		16	0.019	0.006	9.4315	0.895
		17	0.022	0.011	9.7115	0.915
		18	0.051	0.043	11.224	0.885
		19	-0.020	-0.024	11.459	0.907
		20	-0.004	-0.009	11.467	0.933
		21	-0.046	-0.049	12.724	0.918
		22	-0.035	-0.040	13.462	0.919
		23	-0.029	-0.029	13.948	0.928
		24	0.005	0.002	13.965	0.947
		25	-0.037	-0.044	14.777	0.946
		26	0.035	0.020	15.522	0.947
		27	-0.065	-0.075	18.013	0.903
		28	0.027	0.008	18.433	0.915
		29	-0.070	-0.084	21.360	0.846
		30	0.052	0.034	22.993	0.816
		31	0.050	0.041	24.496	0.790
		32	0.020	0.004	24.742	0.816
		33	-0.035	-0.043	25.487	0.822
		34	-0.076	-0.093	28.982	0.712
		35	0.048	0.036	30.352	0.692
		36	0.018	0.004	30.557	0.725

Serial LM Test auf Autokorrelation der Residuen

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.298372	Prob. F(4,557)	0.269449
Obs*R-squared	5.217561	Prob. Chi-Square(4)	0.265694

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 07/19/07 Time: 12:34
Sample: 2003M12 2050M12
Included observations: 565
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RES(-1)	-0.244448	0.926372	-0.263877	0.7920
D(RES(-1))	0.741784	0.655925	1.130897	0.2586
D(RES(-2))	-0.532615	0.641585	-0.830155	0.4068
D(RES(-3))	0.596590	0.507073	1.176538	0.2399
RESID(-1)	-0.505401	0.865296	-0.584078	0.5594
RESID(-2)	0.962214	0.775455	1.240838	0.2152
RESID(-3)	-0.273157	0.169913	-1.607623	0.1085
RESID(-4)	-0.130653	0.079404	-1.645429	0.1004

R-squared	0.009235	Mean dependent var	-0.002244
Adjusted R-squared	-0.003217	S.D. dependent var	1.234506
S.E. of regression	1.236490	Akaike info criterion	3.276489
Sum squared resid	851.6015	Schwarz criterion	3.337895
Log likelihood	-917.6080	Durbin-Watson stat	2.002161

Dickey Fuller Kojntegrationstest

Dependent Variable: D(RES)
Method: Least Squares
Date: 07/19/07 Time: 12:33
Sample (adjusted): 2003M12 2050M12
Included observations: 565 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RES(-1)	-1.169440	0.070125	-16.67639	0.0000
D(RES(-1))	0.776860	0.052948	14.67209	0.0000
D(RES(-2))	0.153932	0.045030	3.418449	0.0007
D(RES(-3))	0.069805	0.042311	1.649794	0.0995

R-squared	0.616590	Mean dependent var	0.007790
Adjusted R-squared	0.614539	S.D. dependent var	1.993710
S.E. of regression	1.237805	Akaike info criterion	3.271610
Sum squared resid	859.5418	Schwarz criterion	3.302313
Log likelihood	-920.2299	Durbin-Watson stat	2.003627

Fehlerkorrektur 1. Möglichkeit

Dependent Variable: D(Y3)
Method: Least Squares
Date: 07/19/07 Time: 12:38
Sample (adjusted): 2003M09 2050M12
Included observations: 568 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.118231	0.081554	1.449718	0.1477
Y3(-1)	-0.009691	0.011598	-0.835549	0.4038
Y4(-1)	-0.003529	0.011470	-0.307696	0.7584

R-squared	0.006449	Mean dependent var	-0.003829
Adjusted R-squared	0.002932	S.D. dependent var	0.505486
S.E. of regression	0.504745	Akaike info criterion	1.475739
Sum squared resid	143.9434	Schwarz criterion	1.498673
Log likelihood	-416.1100	F-statistic	1.833756
Durbin-Watson stat	2.026370	Prob(F-statistic)	0.160762

Fehlerkorrektur 2. Möglichkeit

Dependent Variable: D(Y4)
Method: Least Squares
Date: 07/19/07 Time: 12:40
Sample (adjusted): 2003M09 2050M12
Included observations: 568 after adjustments

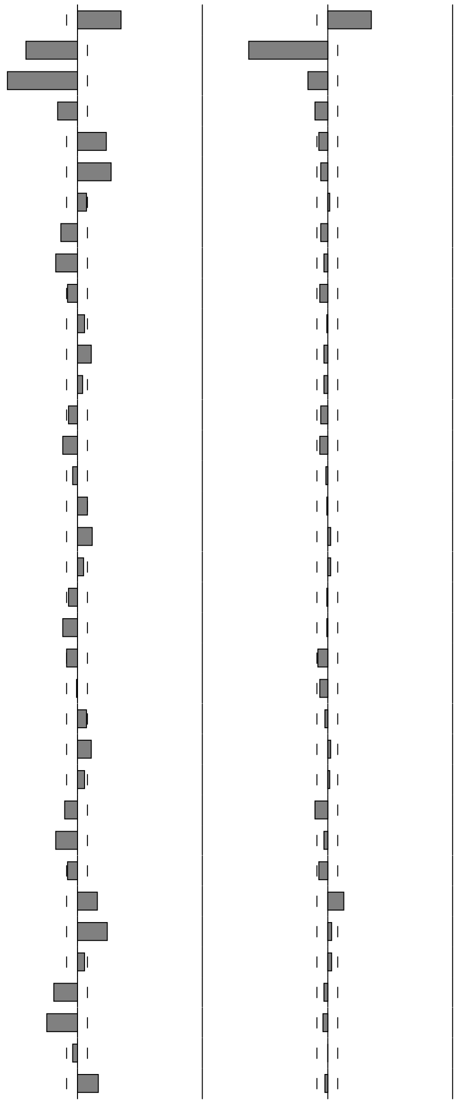
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.779785	0.266299	10.43857	0.0000
Y4(-1)	-0.581567	0.037453	-15.52774	0.0000
Y3(-1)	0.487532	0.037871	12.87339	0.0000

R-squared	0.299181	Mean dependent var	-0.000611
Adjusted R-squared	0.296700	S.D. dependent var	1.965281
S.E. of regression	1.648143	Akaike info criterion	3.842443
Sum squared resid	1534.752	Schwarz criterion	3.865377
Log likelihood	-1088.254	F-statistic	120.5998
Durbin-Watson stat	1.264917	Prob(F-statistic)	0.000000

Correlogram of Residuals

Date: 07/19/07   Time: 12:45
Sample: 2003M09 2050M12
Included observations: 568

Autocorrelation | Partial Correlation



	AC	PAC	Q-Stat	Prob
1	0.367	0.367	77.116	0.000
2	-0.426	-0.648	180.76	0.000
3	-0.575	-0.158	370.31	0.000
4	-0.162	-0.101	385.31	0.000
5	0.246	-0.070	420.05	0.000
6	0.282	-0.051	465.82	0.000
7	0.076	0.024	469.17	0.000
8	-0.132	-0.052	479.30	0.000
9	-0.174	-0.032	496.76	0.000
10	-0.077	-0.060	500.20	0.000
11	0.064	-0.001	502.56	0.000
12	0.117	-0.029	510.47	0.000
13	0.047	-0.029	511.73	0.000
14	-0.069	-0.057	514.48	0.000
15	-0.118	-0.065	522.59	0.000
16	-0.037	-0.016	523.41	0.000
17	0.083	-0.000	527.43	0.000
18	0.127	0.032	536.91	0.000
19	0.055	0.029	538.69	0.000
20	-0.068	-0.007	541.44	0.000
21	-0.117	-0.004	549.58	0.000
22	-0.085	-0.078	553.84	0.000
23	-0.004	-0.062	553.85	0.000
24	0.079	-0.020	557.57	0.000
25	0.116	0.025	565.58	0.000
26	0.060	0.017	567.76	0.000
27	-0.104	-0.103	574.29	0.000
28	-0.173	-0.025	592.17	0.000
29	-0.074	-0.070	595.46	0.000
30	0.169	0.135	612.60	0.000
31	0.251	0.037	650.49	0.000
32	0.062	0.038	652.83	0.000
33	-0.193	-0.026	675.35	0.000
34	-0.248	-0.038	712.49	0.000
35	-0.037	0.001	713.33	0.000
36	0.175	-0.018	732.01	0.000

Gut spezifizierte Fehlerkorrekturgleichung

Dependent Variable: D(Y4)
Method: Least Squares
Date: 07/19/07 Time: 12:47
Sample (adjusted): 2003M10 2050M12
Included observations: 567 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.783731	0.188517	25.37564	0.0000
Y4(-1)	-0.979423	0.028402	-34.48410	0.0000
Y3(-1)	0.808582	0.027339	29.57573	0.0000
D(Y4(-1))	0.737204	0.026722	27.58790	0.0000

R-squared	0.701993	Mean dependent var	7.70E-05
Adjusted R-squared	0.700405	S.D. dependent var	1.966948
S.E. of regression	1.076614	Akaike info criterion	2.992548
Sum squared resid	652.5719	Schwarz criterion	3.023168
Log likelihood	-844.3875	F-statistic	442.0728
Durbin-Watson stat	1.946299	Prob(F-statistic)	0.000000

Correlogram of Residuals

Date: 07/19/07 Time: 12:49
Sample: 2003M10 2050M12
Included observations: 567

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.024	0.024	0.3332	0.564
		2	-0.040	-0.041	1.2666	0.531
		3	-0.019	-0.017	1.4663	0.690
		4	-0.038	-0.039	2.2834	0.684
		5	-0.057	-0.057	4.1471	0.528
		6	-0.110	-0.111	11.080	0.086
		7	-0.009	-0.011	11.123	0.133
		8	-0.004	-0.018	11.133	0.194
		9	0.015	0.005	11.257	0.259
		10	-0.046	-0.061	12.496	0.253
		11	-0.035	-0.047	13.207	0.280
		12	-0.017	-0.036	13.379	0.342
		13	-0.004	-0.013	13.390	0.418
		14	0.011	0.000	13.461	0.491
		15	-0.015	-0.026	13.590	0.557
		16	0.004	-0.016	13.597	0.629
		17	0.023	0.007	13.910	0.673
		18	0.034	0.024	14.590	0.690
		19	0.016	0.013	14.731	0.740
		20	-0.063	-0.066	17.066	0.649
		21	-0.024	-0.029	17.408	0.686
		22	-0.009	-0.016	17.456	0.738
		23	-0.021	-0.022	17.710	0.773
		24	-0.028	-0.029	18.176	0.794
		25	-0.030	-0.042	18.699	0.811
		26	0.049	0.026	20.139	0.785
		27	-0.066	-0.085	22.722	0.700
		28	0.016	0.013	22.884	0.739
		29	-0.078	-0.097	26.573	0.595
		30	0.070	0.060	29.544	0.489
		31	0.066	0.037	32.155	0.409
		32	-0.011	-0.017	32.224	0.456
		33	-0.026	-0.049	32.636	0.485
		34	-0.051	-0.060	34.212	0.458
		35	0.081	0.063	38.168	0.327
		36	0.002	0.008	38.170	0.371