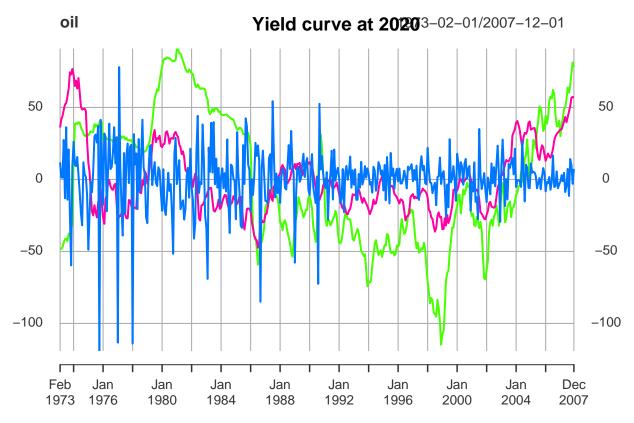
Assignement

Point 1

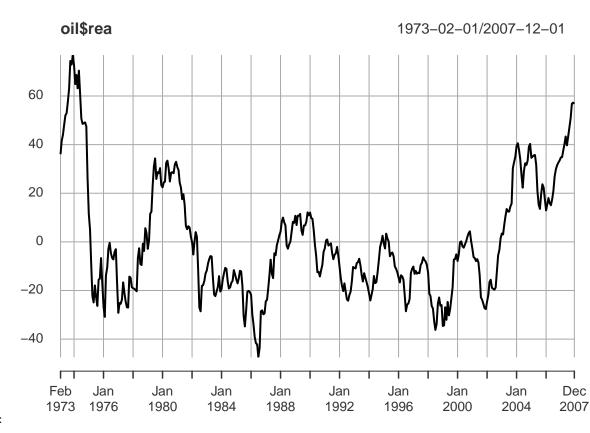
The time series below represents the monthly time series of: 1. % change in global crude oil production 2. the real price of oil 3. the real economy activity From 1973:1 to 2007:12.



As we can see the acf its clear signaling the presence of an autcorrelation process. In order to test if the rea is an I(1), we will use an ADF test with lag =1. We will perform the test specifing four different type of the process: 1. No consant, no trend 2. Constant 3. Constant with trend 4. No costant with trend First, we print the first times series graph. We perform the different type of the test with a maximum lag order of 12:

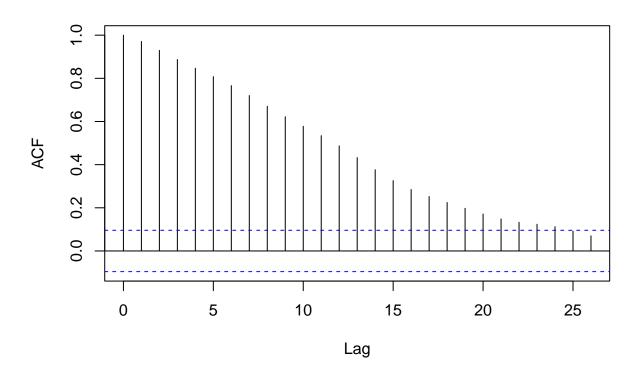
$$rea_t = \alpha + \sigma_1 reat_l(t-1) + \dots + \sigma_1 2\delta reat_l(t-13)$$

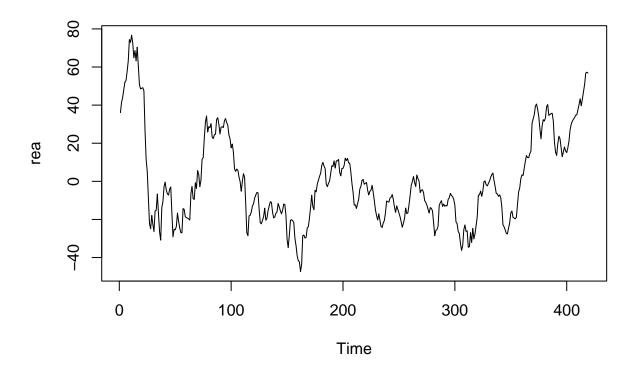
We take the model with constant, otherwise the model will be too restricive, and without time trend, selectin the



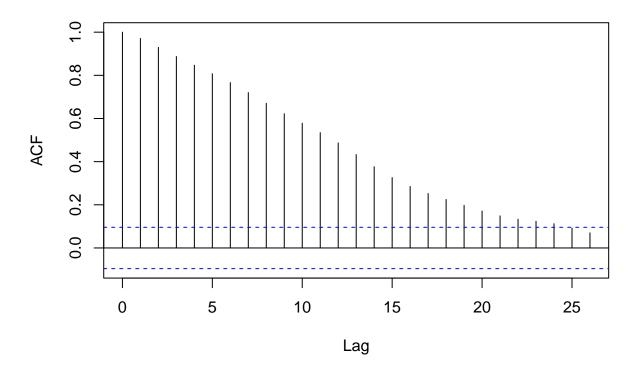
one which as lower BIC:

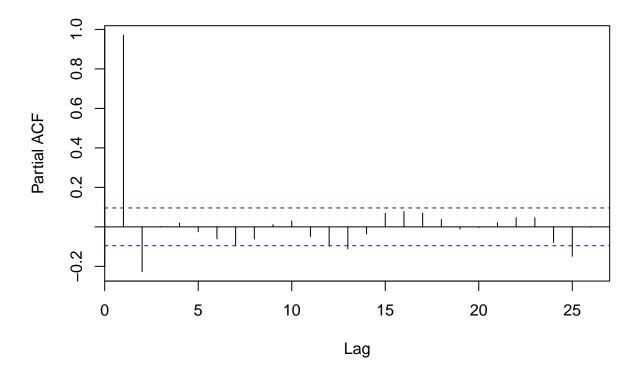
Series oil\$rea











rw 1 no drift no trend 1 -1.6457 0.0961 No Stat. No Stat. rw 1 with drift no trend 1 -1.6443 0.4692 No Stat. No Stat.	
rw 1 with drift no trend 1 -1.6443 0.4692 No Stat. No Stat.	
rw 1 with drift and trend 1 -1.6235 0.736 No Stat. No Stat.	
rw 2 no drift no trend 1 -1.6457 0.0961 No Stat. No Stat.	
rw 2 no drift no trend 2 -2.5702 0.0104 Stat No Stat.	
rw 2 with drift no trend 1 -1.6443 0.4692 No Stat. No Stat.	
rw 2 with drift no trend 2 -2.5669 0.1025 No Stat. No Stat.	
rw 2 with drift and trend 1 -1.6235 0.736 No Stat. No Stat.	
rw 2 with drift and trend 2 -2.5446 0.3465 No Stat. No Stat.	
rw 3 no drift no trend 1 -1.6457 0.0961 No Stat. No Stat.	
rw 3 no drift no trend 2 -2.5702 0.0104 Stat No Stat.	
rw 3 no drift no trend 3 -2.4271 0.0166 Stat No Stat.	
rw 3 with drift no trend 1 -1.6443 0.4692 No Stat. No Stat.	
rw 3 with drift no trend 2 -2.5669 0.1025 No Stat. No Stat.	
rw 3 with drift no trend 3 -2.4235 0.1595 No Stat. No Stat.	
rw 3 with drift and trend 1 -1.6235 0.736 No Stat. No Stat.	
rw 3 with drift and trend 2 -2.5446 0.3465 No Stat. No Stat.	
rw 3 with drift and trend 3 -2.3969 0.4087 No Stat. No Stat.	
rw 4 no drift no trend 1 -1.6457 0.0961 No Stat. No Stat.	
rw 4 no drift no trend 2 -2.5702 0.0104 Stat No Stat.	
rw 4 no drift no trend 3 -2.4271 0.0166 Stat No Stat.	
rw 4 no drift no trend 4 -2.4375 0.0162 Stat No Stat.	
rw 4 with drift no trend 1 -1.6443 0.4692 No Stat. No Stat.	
rw 4 with drift no trend 2 -2.5669 0.1025 No Stat. No Stat.	

-	N of lags	Type	lag	ADF	p.value	Stationary at 5%	Stationary at 10%
rw	4	with drift no trend	3	-2.4235	0.1595	No Stat.	No Stat.
rw	4	with drift no trend	4	-2.4339	0.1554	No Stat.	No Stat.
rw	4	with drift and trend	1	-1.6235	0.736	No Stat.	No Stat.
rw	4	with drift and trend	2	-2.5446	0.3465	No Stat.	No Stat.
rw	$\overline{4}$	with drift and trend	3	-2.3969	0.4087	No Stat.	No Stat.
rw	4	with drift and trend	4	-2.4043	0.4055	No Stat.	No Stat.
rw	5	no drift no trend	1	-1.6457	0.0961	No Stat.	No Stat.
rw	5	no drift no trend	2	-2.5702	0.0104	Stat	No Stat.
rw	5	no drift no trend	3	-2.4271	0.0166	Stat	No Stat.
rw	5	no drift no trend	4	-2.4375	0.0162	Stat	No Stat.
rw	5	no drift no trend	5	-2.5514	0.0112	Stat	No Stat.
rw	5	with drift no trend	1	-1.6443	0.4692	No Stat.	No Stat.
rw	5	with drift no trend	2	-2.5669	0.1025	No Stat.	No Stat.
rw	5	with drift no trend	3	-2.4235	0.1595	No Stat.	No Stat.
rw	5	with drift no trend	4	-2.4339	0.1554	No Stat.	No Stat.
rw	5	with drift no trend	5	-2.5482	0.11	No Stat.	No Stat.
rw	5	with drift and trend	1	-1.6235	0.736	No Stat.	No Stat.
rw	5	with drift and trend	2	-2.5446	0.3465	No Stat.	No Stat.
rw	5	with drift and trend	3	-2.3969	0.4087	No Stat.	No Stat.
rw	5	with drift and trend	4	-2.4043	0.4055	No Stat.	No Stat.
rw	5	with drift and trend	5	-2.5178	0.3578	No Stat.	No Stat.
rw	6	no drift no trend	1	-1.6457	0.0961	No Stat.	No Stat.
rw	6	no drift no trend	2	-2.5702	0.0104	Stat	No Stat.
rw	6	no drift no trend	3	-2.4271	0.0166	Stat	No Stat.
rw	6	no drift no trend	4	-2.4271 -2.4375	0.0160 0.0162	Stat	No Stat.
rw	6	no drift no trend	5	-2.4516 -2.5514	0.0102 0.0112	Stat	No Stat.
rw	6	no drift no trend	6	-2.801	0.0112	Stat	Stat
rw	6	with drift no trend	1	-1.6443	0.4692	No Stat.	No Stat.
rw	6	with drift no trend	2	-2.5669	0.4032 0.1025	No Stat.	No Stat.
rw	6	with drift no trend	3	-2.4235	0.1525 0.1595	No Stat.	No Stat.
rw	6	with drift no trend	4	-2.4239	0.1554	No Stat.	No Stat.
rw	6	with drift no trend	5	-2.4339 -2.5482	0.1354 0.11	No Stat.	No Stat.
rw	6	with drift no trend	6	-2.7977	0.0626	No Stat.	No Stat.
rw	6	with drift and trend	1	-1.6235	0.736	No Stat.	No Stat.
rw	6	with drift and trend with drift and trend	2	-2.5446	0.736 0.3465	No Stat.	No Stat.
rw	6	with drift and trend	3	-2.3969	0.3403 0.4087	No Stat.	No Stat.
	6	with drift and trend with drift and trend	4	-2.4043	0.4057	No Stat.	No Stat.
rw	6	with drift and trend with drift and trend	5	-2.4043 -2.5178	0.4055 0.3578	No Stat.	No Stat.
rw	6	with drift and trend with drift and trend	6	-2.7702	0.3575 0.2515	No Stat.	No Stat.
rw	7	no drift no trend	1	-2.7702 -1.6457	0.2913 0.0961	No Stat.	No Stat. No Stat.
rw	7	no drift no trend	2	-2.5702	0.0104	Stat	No Stat.
rw	7	no drift no trend	3	-2.3702 -2.4271	0.0164 0.0166	Stat	No Stat.
rw	7	no drift no trend	4	-2.4271 -2.4375	0.0160 0.0162	Stat	No Stat.
rw	7	no drift no trend	5	-2.4575 -2.5514	0.0102 0.0112	Stat	No Stat.
rw		no drift no trend	6	-2.801	0.0112 0.01	Stat	Stat
rw	7 7	no drift no trend	7	-2.001 -3.2152	0.01	Stat	Stat
rw	7 7	with drift no trend	1	-3.2132 -1.6443	0.01 0.4692	No Stat.	No Stat.
rw	7 7	with drift no trend	$\frac{1}{2}$	-1.0445 -2.5669	0.4092 0.1025	No Stat. No Stat.	No Stat. No Stat.
rw	7 7	with drift no trend	$\frac{2}{3}$	-2.3009 -2.4235	0.1025 0.1595	No Stat. No Stat.	No Stat.
rw	7 7	with drift no trend	3 4	-2.4235 -2.4339	0.1595 0.1554	No Stat. No Stat.	No Stat.
rw		with drift no trend	4 5	-2.4339 -2.5482	0.1334 0.11	No Stat. No Stat.	No Stat.
rw	7						
rw	7	with drift no trend	6	-2.7977	0.0626	No Stat.	No Stat.

	N of lags	Type	lag	ADF	p.value	Stationary at 5%	Stationary at 10%
rw	7	with drift no trend	7	-3.2132	0.0211	Stat	No Stat.
rw	7	with drift and trend	1	-1.6235	0.736	No Stat.	No Stat.
rw	7	with drift and trend	2	-2.5446	0.3465	No Stat.	No Stat.
rw	7	with drift and trend	3	-2.3969	0.4087	No Stat.	No Stat.
rw	7	with drift and trend	4	-2.4043	0.4055	No Stat.	No Stat.
rw	7	with drift and trend	5	-2.5178	0.3578	No Stat.	No Stat.
rw	7	with drift and trend	6	-2.7702	0.2515	No Stat.	No Stat.
rw	7	with drift and trend	7	-3.1891	0.0898	No Stat.	No Stat.
rw	8	no drift no trend	1	-1.6457	0.0961	No Stat.	No Stat.
rw	8	no drift no trend	2	-2.5702	0.0104	Stat	No Stat.
rw	8	no drift no trend	3	-2.4271	0.0166	Stat	No Stat.
rw	8	no drift no trend	4	-2.4375	0.0162	Stat	No Stat.
rw	8	no drift no trend	5	-2.5514	0.0112	Stat	No Stat.
rw	8	no drift no trend	6	-2.801	0.01	Stat	Stat
rw	8	no drift no trend	7	-3.2152	0.01	Stat	Stat
rw	8	no drift no trend	8	-3.3318	0.01	Stat	Stat
rw	8	with drift no trend	1	-1.6443	0.4692	No Stat.	No Stat.
rw	8	with drift no trend	2	-2.5669	0.1025	No Stat.	No Stat.
rw	8	with drift no trend	3	-2.4235	0.1595	No Stat.	No Stat.
rw	8	with drift no trend	4	-2.4339	0.1554	No Stat.	No Stat.
rw	8	with drift no trend	5	-2.5482	0.11	No Stat.	No Stat.
rw	8	with drift no trend	6	-2.7977	0.0626	No Stat.	No Stat.
rw	8	with drift no trend	7	-3.2132	0.0211	Stat	No Stat.
rw	8	with drift no trend	8	-3.3321	0.0154	Stat	No Stat.
rw	8	with drift and trend	1	-1.6235	0.736	No Stat.	No Stat.
rw	8	with drift and trend	2	-2.5446	0.3465	No Stat.	No Stat.
rw	8	with drift and trend	3	-2.3969	0.4087	No Stat.	No Stat.
rw	8	with drift and trend	4	-2.4043	0.4055	No Stat.	No Stat.
rw	8	with drift and trend	5	-2.5178	0.3578	No Stat.	No Stat.
rw	8	with drift and trend	6	-2.7702	0.2515	No Stat.	No Stat.
rw	8	with drift and trend	7	-3.1891	0.0898	No Stat.	No Stat.
rw	8	with drift and trend	8	-3.3119	0.0686	No Stat.	No Stat.
rw	9	no drift no trend	1	-1.6457	0.0961	No Stat.	No Stat.
rw	9	no drift no trend	2	-2.5702	0.0104	Stat	No Stat.
rw	9	no drift no trend	3	-2.4271	0.0166	Stat	No Stat.
rw	9	no drift no trend	4	-2.4375	0.0162	Stat	No Stat.
rw	9	no drift no trend	5	-2.5514	0.0112	Stat	No Stat.
rw	9	no drift no trend	6	-2.801	0.01	Stat	Stat
rw	9	no drift no trend	7	-3.2152	0.01	Stat	Stat
rw	9	no drift no trend	8	-3.3318	0.01	Stat	Stat
rw	9	no drift no trend	9	-3.4479	0.01	Stat	Stat
rw	9	with drift no trend	1	-1.6443	0.4692	No Stat.	No Stat.
rw	9	with drift no trend	2	-2.5669	0.1025	No Stat.	No Stat.
rw	9	with drift no trend	3	-2.4235	0.1595	No Stat.	No Stat.
rw	9	with drift no trend	4	-2.4339	0.1554	No Stat.	No Stat.
rw	9	with drift no trend	5	-2.5482	0.11	No Stat.	No Stat.
rw	9	with drift no trend	6	-2.7977	0.0626	No Stat.	No Stat.
rw	9	with drift no trend	7	-3.2132	0.0211	Stat	No Stat.
rw	9	with drift no trend	8	-3.3321	0.0154	Stat	No Stat.
rw	9	with drift no trend	9	-3.454	0.01	Stat	Stat
rw	9	with drift and trend	1	-1.6235	0.736	No Stat.	No Stat.
rw	9	with drift and trend	2	-2.5446	0.3465	No Stat.	No Stat.

	N of lags	Type	lag	ADF	p.value	Stationary at 5%	Stationary at 10%
rw	9	with drift and trend	3	-2.3969	0.4087	No Stat.	No Stat.
rw	9	with drift and trend	4	-2.4043	0.4055	No Stat.	No Stat.
·w	9	with drift and trend	5	-2.5178	0.3578	No Stat.	No Stat.
rw	9	with drift and trend	6	-2.7702	0.2515	No Stat.	No Stat.
rw	9	with drift and trend	7	-3.1891	0.0898	No Stat.	No Stat.
rw	9	with drift and trend	8	-3.3119	0.0686	No Stat.	No Stat.
rw	9	with drift and trend	9	-3.4427	0.0478	Stat	No Stat.
rw	10	no drift no trend	1	-1.6457	0.0961	No Stat.	No Stat.
rw	10	no drift no trend	2	-2.5702	0.0104	Stat	No Stat.
rw	10	no drift no trend	3	-2.4271	0.0166	Stat	No Stat.
rw	10	no drift no trend	4	-2.4375	0.0162	Stat	No Stat.
rw	10	no drift no trend	5	-2.5514	0.0112	Stat	No Stat.
rw	10	no drift no trend	6	-2.801	0.01	Stat	Stat
rw	10	no drift no trend	7	-3.2152	0.01	Stat	Stat
rw	10	no drift no trend	8	-3.3318	0.01	Stat	Stat
rw	10	no drift no trend	9	-3.4479	0.01	Stat	Stat
rw	10	no drift no trend	10	-3.2258	0.01	Stat	Stat
rw	10	with drift no trend	1	-1.6443	0.4692	No Stat.	No Stat.
rw	10	with drift no trend	2	-2.5669	0.1025	No Stat.	No Stat.
rw	10	with drift no trend	3	-2.4235	0.1595	No Stat.	No Stat.
rw	10	with drift no trend	4	-2.4339	0.1554	No Stat.	No Stat.
rw	10	with drift no trend	5	-2.5482	0.11	No Stat.	No Stat.
rw	10	with drift no trend	6	-2.7977	0.0626	No Stat.	No Stat.
rw	10	with drift no trend	7	-3.2132	0.0211	Stat	No Stat.
rw	10	with drift no trend	8	-3.3321	0.0154	Stat	No Stat.
rw	10	with drift no trend	9	-3.454	0.01	Stat	Stat
rw	10	with drift no trend	10	-3.2318	0.0202	Stat	No Stat.
rw	10	with drift and trend	1	-1.6235	0.736	No Stat.	No Stat.
rw	10	with drift and trend	2	-2.5446	0.3465	No Stat.	No Stat.
rw	10	with drift and trend	3	-2.3969	0.4087	No Stat.	No Stat.
rw	10	with drift and trend	4	-2.4043	0.4055	No Stat.	No Stat.
rw	10	with drift and trend	5	-2.5178	0.3578	No Stat.	No Stat.
rw	10	with drift and trend	6	-2.7702	0.2515	No Stat.	No Stat.
rw	10	with drift and trend	7	-3.1891	0.0898	No Stat.	No Stat.
ľW	10	with drift and trend	8	-3.3119	0.0686	No Stat.	No Stat.
	10	with drift and trend	9	-3.4427	0.0478	Stat	No Stat.
rw	10	with drift and trend	10	-3.2348	0.0478 0.0819	No Stat.	No Stat.
rw	11	no drift no trend	10	-3.2348 -1.6457	0.0819 0.0961	No Stat.	No Stat.
rw	11	no drift no trend		-2.5702	0.0901 0.0104	Stat	No Stat.
rw	11	no drift no trend	$\frac{2}{3}$	-2.3702 -2.4271	0.0104 0.0166	Stat	No Stat. No Stat.
rw		no drift no trend			0.0160 0.0162		
rw	11		4	-2.4375		Stat	No Stat.
rw	11	no drift no trend	5 c	-2.5514	0.0112	Stat	No Stat.
rw	11	no drift no trend	6	-2.801	0.01	Stat	Stat
rw	11	no drift no trend	7	-3.2152	0.01	Stat	Stat
rw	11	no drift no trend	8	-3.3318	0.01	Stat	Stat
rw	11	no drift no trend	9	-3.4479	0.01	Stat	Stat
rw	11	no drift no trend	10	-3.2258	0.01	Stat	Stat
rw	11	no drift no trend	11	-3.5172	0.01	Stat	Stat
rw	11	with drift no trend	1	-1.6443	0.4692	No Stat.	No Stat.
rw	11	with drift no trend	2	-2.5669	0.1025	No Stat.	No Stat.
rw	11	with drift no trend	3	-2.4235	0.1595	No Stat.	No Stat.
rw	11	with drift no trend	4	-2.4339	0.1554	No Stat.	No Stat.

	N of lags	Type	lag	ADF	p.value	Stationary at 5%	Stationary at 10%
rw	11	with drift no trend	5	-2.5482	0.11	No Stat.	No Stat.
rw	11	with drift no trend	6	-2.7977	0.0626	No Stat.	No Stat.
rw	11	with drift no trend	7	-3.2132	0.0211	Stat	No Stat.
rw	11	with drift no trend	8	-3.3321	0.0154	Stat	No Stat.
rw	11	with drift no trend	9	-3.454	0.01	Stat	Stat
rw	11	with drift no trend	10	-3.2318	0.0202	Stat	No Stat.
rw	11	with drift no trend	11	-3.529	0.01	Stat	Stat
rw	11	with drift and trend	1	-1.6235	0.736	No Stat.	No Stat.
rw	11	with drift and trend	2	-2.5446	0.3465	No Stat.	No Stat.
rw	11	with drift and trend	3	-2.3969	0.4087	No Stat.	No Stat.
rw	11	with drift and trend	4	-2.4043	0.4055	No Stat.	No Stat.
rw	11	with drift and trend	5	-2.5178	0.3578	No Stat.	No Stat.
rw	11	with drift and trend	6	-2.7702	0.2515	No Stat.	No Stat.
rw	11	with drift and trend	7	-3.1891	0.0898	No Stat.	No Stat.
rw	11	with drift and trend	8	-3.3119	0.0686	No Stat.	No Stat.
rw	11	with drift and trend	9	-3.4427	0.0478	Stat	No Stat.
rw	11	with drift and trend	10	-3.2348	0.0819	No Stat.	No Stat.
rw	11	with drift and trend	11	-3.5484	0.0375	Stat	No Stat.
rw	12	no drift no trend	1	-1.6457	0.0961	No Stat.	No Stat.
rw	12	no drift no trend	2	-2.5702	0.0104	Stat	No Stat.
rw	12	no drift no trend	3	-2.4271	0.0166	Stat	No Stat.
rw	12	no drift no trend	4	-2.4375	0.0162	Stat	No Stat.
rw	12	no drift no trend	5	-2.5514	0.0112	Stat	No Stat.
rw	12	no drift no trend	6	-2.801	0.01	Stat	Stat
rw	12	no drift no trend	7	-3.2152	0.01	Stat	Stat
rw	12	no drift no trend	8	-3.3318	0.01	Stat	Stat
rw	12	no drift no trend	9	-3.4479	0.01	Stat	Stat
rw	12	no drift no trend	10	-3.2258	0.01	Stat	Stat
rw	12	no drift no trend	11	-3.5172	0.01	Stat	Stat
rw	12	no drift no trend	12	-3.8179	0.01	Stat	Stat
rw	12	with drift no trend	1	-1.6443	0.4692	No Stat.	No Stat.
rw	12	with drift no trend	2	-2.5669	0.1025	No Stat.	No Stat.
rw	12	with drift no trend	3	-2.4235	0.1595	No Stat.	No Stat.
rw	12	with drift no trend	4	-2.4339	0.1554	No Stat.	No Stat.
rw	12	with drift no trend	5	-2.5482	0.11	No Stat.	No Stat.
rw	12	with drift no trend	6	-2.7977	0.0626	No Stat.	No Stat.
rw	12	with drift no trend	7	-3.2132	0.0211	Stat	No Stat.
rw	12	with drift no trend	8	-3.3321	0.0154	Stat	No Stat.
rw	12	with drift no trend	9	-3.454	0.01	Stat	Stat
rw	12	with drift no trend	10	-3.2318	0.0202	Stat	No Stat.
rw	12	with drift no trend	11	-3.529	0.01	Stat	Stat
rw	12	with drift no trend	12	-3.8297	0.01	Stat	Stat
rw	12	with drift and trend	1	-1.6235	0.736	No Stat.	No Stat.
rw	12	with drift and trend	2	-2.5446	0.3465	No Stat.	No Stat.
rw	12	with drift and trend	3	-2.3969	0.4087	No Stat.	No Stat.
rw	12	with drift and trend	4	-2.4043	0.4055	No Stat.	No Stat.
rw	12	with drift and trend	5	-2.5178	0.3578	No Stat.	No Stat.
rw	12	with drift and trend	6	-2.7702	0.2515	No Stat.	No Stat.
rw	12	with drift and trend	7	-3.1891	0.0898	No Stat.	No Stat.
rw	12	with drift and trend	8	-3.3119	0.0686	No Stat.	No Stat.
rw	12	with drift and trend	9	-3.4427	0.0478	Stat	No Stat.
rw	12	with drift and trend	10	-3.2348	0.0819	No Stat.	No Stat.
1 W	14	with and tiella	TO	-0.2040	0.0019	no stat.	no stat.

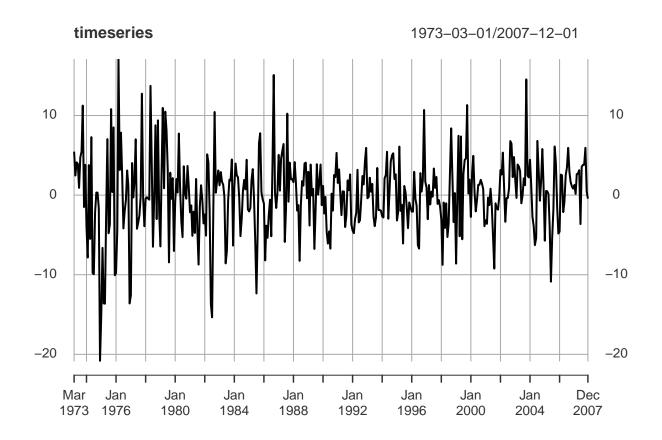
	N of lags	Type	lag	ADF	p.value	Stationary at 5%	Stationary at 10%
rw rw	12 12	with drift and trend with drift and trend		-3.5484 -3.863	0.0375 0.0156	Stat Stat	No Stat. No Stat.

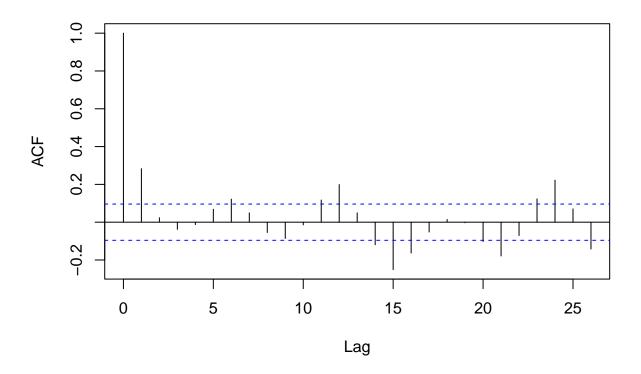
```
## $`ADF Statistic using BIC`
   [1] -4.252854
##
##
                 N of lags
                                               Туре
                                                                         lag
                                                                         "12"
##
                      "12"
                            "with drift and trend"
##
                       ADF
                                            p.value
                                                           Stationary at 5%
                                           "0.0156"
                  "-3.863"
                                                                      "Stat"
##
##
        Stationary at 10%
##
                "No Stat."
```

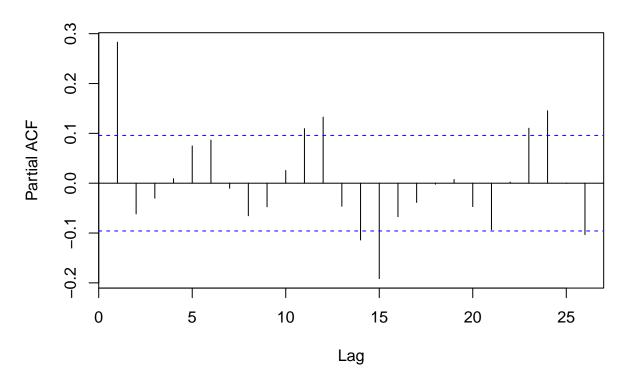
As we can see from the table above which report the result of the ADF tests, it is clear that the process is not stationary with a alpha < 10, so there are no sufficent empirical evidence to reject the null. Thus the rea time series is not a covariance-stationary process with a minimum lag of order 1.

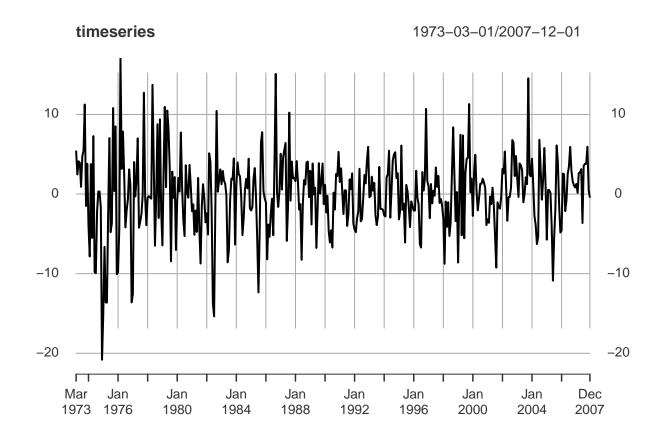
Point 2

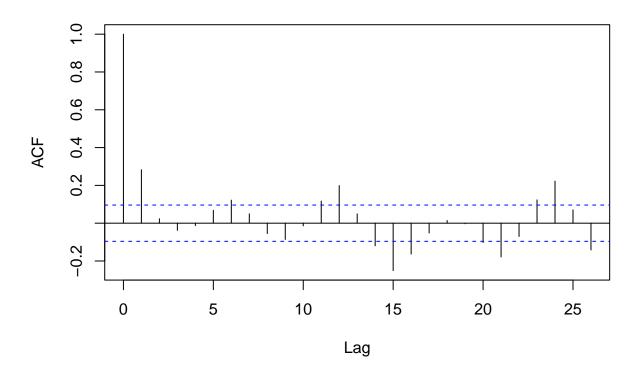
We take the first difference of the timeseries rea and check if it is stationary with an adf test. Before that we print the time series of the first differences, the acf, and the pacf to understat the correct specification for the ADF test.

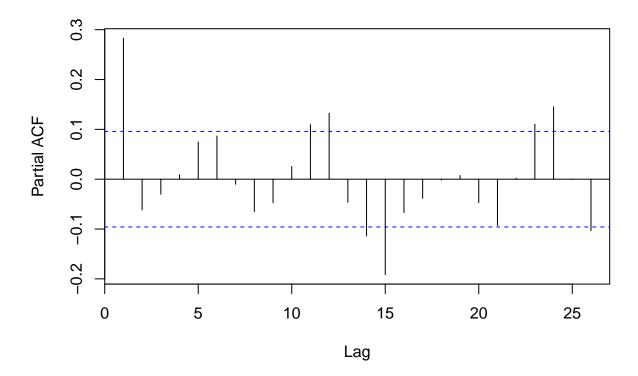












The above graphs clearly underline stationarity of the process, indeed the acf for the lag > 2 the partial autcorrelation is not statistically different from 0. As for the partial autcorrelation that is statistically different only for some lag>10. From the plot of the time series we can see a mean reverting process, and so I will opt for the specification without time trend and constant. so the test will have the following specification:

$$\delta rea_t = \sigma_1 \delta reat_(t-1) + \dots + \sigma_1 2 \delta reat_(t-13)$$

The test will be performed with all passible four specification, and will be selected the specification with lower adf value.

	N of lags	Type	lag	ADF	p.value	Stationary at 5%	Stationary at 10%
rw	1	no drift no trend	1	15.2068	0.99	No Stat.	No Stat.
rw	1	with drift no trend	1	15.19	0.99	No Stat.	No Stat.
rw	1	with drift and trend	1	15.2459	0.99	No Stat.	No Stat.
rw	2	no drift no trend	1	15.2068	0.99	No Stat.	No Stat.
rw	2	no drift no trend	2	21.1956	0.99	No Stat.	No Stat.
rw	2	with drift no trend	1	15.19	0.99	No Stat.	No Stat.
rw	2	with drift no trend	2	21.172	0.99	No Stat.	No Stat.
rw	2	with drift and trend	1	15.2459	0.99	No Stat.	No Stat.
rw	2	with drift and trend	2	21.306	0.99	No Stat.	No Stat.
rw	3	no drift no trend	1	15.2068	0.99	No Stat.	No Stat.
rw	3	no drift no trend	2	21.1956	0.99	No Stat.	No Stat.
rw	3	no drift no trend	3	26.3129	0.99	No Stat.	No Stat.
rw	3	with drift no trend	1	15.19	0.99	No Stat.	No Stat.
rw	3	with drift no trend	2	21.172	0.99	No Stat.	No Stat.
rw	3	with drift no trend	3	26.2829	0.99	No Stat.	No Stat.
rw	3	with drift and trend	1	15.2459	0.99	No Stat.	No Stat.

	N of lags	Type	lag	ADF	p.value	Stationary at 5%	Stationary at 10%
rw	3	with drift and trend	2	21.306	0.99	No Stat.	No Stat.
w	3	with drift and trend	3	26.5082	0.99	No Stat.	No Stat.
rw	4	no drift no trend	1	15.2068	0.99	No Stat.	No Stat.
w	4	no drift no trend	2	21.1956	0.99	No Stat.	No Stat.
rw	4	no drift no trend	3	26.3129	0.99	No Stat.	No Stat.
rw	4	no drift no trend	4	30.6551	0.99	No Stat.	No Stat.
rw	4	with drift no trend	1	15.19	0.99	No Stat.	No Stat.
rw	4	with drift no trend	2	21.172	0.99	No Stat.	No Stat.
rw	4	with drift no trend	3	26.2829	0.99	No Stat.	No Stat.
w	4	with drift no trend	4	30.6192	0.99	No Stat.	No Stat.
rw	4	with drift and trend	1	15.2459	0.99	No Stat.	No Stat.
rw	4	with drift and trend	2	21.306	0.99	No Stat.	No Stat.
rw	4	with drift and trend	3	26.5082	0.99	No Stat.	No Stat.
rw	4	with drift and trend	4	30.9558	0.99	No Stat.	No Stat.
rw	5	no drift no trend	1	15.2068	0.99	No Stat.	No Stat.
rw	5	no drift no trend	2	21.1956	0.99	No Stat.	No Stat.
rw	5	no drift no trend	3	26.3129	0.99	No Stat.	No Stat.
rw	5	no drift no trend	4	30.6551	0.99	No Stat.	No Stat.
rw	5	no drift no trend	5	34.0132	0.99	No Stat.	No Stat.
rw	5	with drift no trend	1	15.19	0.99	No Stat.	No Stat.
rw	5	with drift no trend	2	21.172	0.99	No Stat.	No Stat.
w	5	with drift no trend	3	26.2829	0.99	No Stat.	No Stat.
rw	5	with drift no trend	4	30.6192	0.99	No Stat.	No Stat.
rw	5	with drift no trend	5	33.9723	0.99	No Stat.	No Stat.
rw	5	with drift and trend	1	15.2459	0.99	No Stat.	No Stat.
rw	5	with drift and trend	2	21.306	0.99	No Stat.	No Stat.
rw	5	with drift and trend	3	26.5082	0.99	No Stat.	No Stat.
w	5	with drift and trend	4	30.9558	0.99	No Stat.	No Stat.
rw	5	with drift and trend	5	34.4187	0.99	No Stat.	No Stat.
rw	6	no drift no trend	1	15.2068	0.99	No Stat.	No Stat.
rw	6	no drift no trend	2	21.1956	0.99	No Stat.	No Stat.
rw	6	no drift no trend	3	26.3129	0.99	No Stat.	No Stat.
rw	6	no drift no trend	4	30.6551	0.99	No Stat.	No Stat.
rw	6	no drift no trend	5	34.0132	0.99	No Stat.	No Stat.
rw	6	no drift no trend	6	36.5455	0.99	No Stat.	No Stat.
rw	6	with drift no trend	1	15.19	0.99	No Stat.	No Stat.
rw	6	with drift no trend	2	21.172	0.99	No Stat.	No Stat.
rw	6	with drift no trend	3	26.2829	0.99	No Stat.	No Stat.
rw	6	with drift no trend	4	30.6192	0.99	No Stat.	No Stat.
rw	6	with drift no trend	5	33.9723	0.99	No Stat.	No Stat.
rw	6	with drift no trend	6	36.5007	0.99	No Stat.	No Stat.
rw	6	with drift and trend	1	15.2459	0.99	No Stat.	No Stat.
rw	6	with drift and trend	2	21.306	0.99	No Stat.	No Stat.
rw	6	with drift and trend	3	26.5082	0.99	No Stat.	No Stat.
rw	6	with drift and trend	4	30.9558	0.99	No Stat.	No Stat.
rw	6	with drift and trend	5	34.4187	0.99	No Stat.	No Stat.
rw	6	with drift and trend	6	37.0336	0.99	No Stat.	No Stat.
rw	7	no drift no trend	1	15.2068	0.99	No Stat.	No Stat.
rw	7	no drift no trend	2	21.1956	0.99	No Stat.	No Stat.
rw	7	no drift no trend	$\frac{2}{3}$	26.3129	0.99	No Stat.	No Stat.
rw	7	no drift no trend	4	30.6551	0.99	No Stat.	No Stat.
		TO GLITT HO HEHU	-1	90.0091	0.00	No Stat.	no boat.

	N of lags	Type	lag	ADF	p.value	Stationary at 5%	Stationary at 10%
rw	7	no drift no trend	6	36.5455	0.99	No Stat.	No Stat.
w	7	no drift no trend	7	38.861	0.99	No Stat.	No Stat.
w	7	with drift no trend	1	15.19	0.99	No Stat.	No Stat.
w	7	with drift no trend	2	21.172	0.99	No Stat.	No Stat.
w	7	with drift no trend	3	26.2829	0.99	No Stat.	No Stat.
w	7	with drift no trend	4	30.6192	0.99	No Stat.	No Stat.
w	7	with drift no trend	5	33.9723	0.99	No Stat.	No Stat.
w	7	with drift no trend	6	36.5007	0.99	No Stat.	No Stat.
w	7	with drift no trend	7	38.8127	0.99	No Stat.	No Stat.
w	7	with drift and trend	1	15.2459	0.99	No Stat.	No Stat.
w	7	with drift and trend	2	21.306	0.99	No Stat.	No Stat.
w	7	with drift and trend	3	26.5082	0.99	No Stat.	No Stat.
w	7	with drift and trend	4	30.9558	0.99	No Stat.	No Stat.
w	7	with drift and trend	5	34.4187	0.99	No Stat.	No Stat.
w	7	with drift and trend	6	37.0336	0.99	No Stat.	No Stat.
w	7	with drift and trend	7	39.4714	0.99	No Stat.	No Stat.
w	8	no drift no trend	1	15.2068	0.99	No Stat.	No Stat.
w	8	no drift no trend	2	21.1956	0.99	No Stat.	No Stat.
w	8	no drift no trend	3	26.3129	0.99	No Stat.	No Stat.
w	8	no drift no trend	4	30.6551	0.99	No Stat.	No Stat.
	8	no drift no trend	5	34.0132	0.99	No Stat.	No Stat.
W	8	no drift no trend	6	36.5455	0.99	No Stat.	No Stat.
W	8	no drift no trend	7	38.861	0.99	No Stat.	No Stat.
W		no drift no trend		41.0263		No Stat. No Stat.	No Stat.
W	8		8		0.99		
W	8	with drift no trend	1	15.19	0.99	No Stat.	No Stat.
W	8	with drift no trend	2	21.172	0.99	No Stat.	No Stat.
W	8	with drift no trend	3	26.2829	0.99	No Stat.	No Stat.
W	8	with drift no trend	4	30.6192	0.99	No Stat.	No Stat.
·W	8	with drift no trend	5	33.9723	0.99	No Stat.	No Stat.
·W	8	with drift no trend	6	36.5007	0.99	No Stat.	No Stat.
W	8	with drift no trend	7	38.8127	0.99	No Stat.	No Stat.
·W	8	with drift no trend	8	40.9741	0.99	No Stat.	No Stat.
w	8	with drift and trend	1	15.2459	0.99	No Stat.	No Stat.
w	8	with drift and trend	2	21.306	0.99	No Stat.	No Stat.
W	8	with drift and trend	3	26.5082	0.99	No Stat.	No Stat.
w	8	with drift and trend	4	30.9558	0.99	No Stat.	No Stat.
w	8	with drift and trend	5	34.4187	0.99	No Stat.	No Stat.
w	8	with drift and trend	6	37.0336	0.99	No Stat.	No Stat.
w	8	with drift and trend	7	39.4714	0.99	No Stat.	No Stat.
w	8	with drift and trend	8	41.7807	0.99	No Stat.	No Stat.
w	9	no drift no trend	1	15.2068	0.99	No Stat.	No Stat.
w	9	no drift no trend	2	21.1956	0.99	No Stat.	No Stat.
w	9	no drift no trend	3	26.3129	0.99	No Stat.	No Stat.
w	9	no drift no trend	4	30.6551	0.99	No Stat.	No Stat.
w	9	no drift no trend	5	34.0132	0.99	No Stat.	No Stat.
w	9	no drift no trend	6	36.5455	0.99	No Stat.	No Stat.
w	9	no drift no trend	7	38.861	0.99	No Stat.	No Stat.
w	9	no drift no trend	8	41.0263	0.99	No Stat.	No Stat.
w	9	no drift no trend	9	43.5492	0.99	No Stat.	No Stat.
w	9	with drift no trend	1	15.19	0.99	No Stat.	No Stat.
w	9	with drift no trend	2	21.172	0.99	No Stat.	No Stat.
	9	with drift no trend	3	26.2829	0.99	No Stat.	No Stat.

	N of lags	Туре	lag	ADF	p.value	Stationary at 5%	Stationary at 10%
	9	with drift no trend	4	30.6192	0.99	No Stat.	No Stat.
	9	with drift no trend	5	33.9723	0.99	No Stat.	No Stat.
W	9	with drift no trend	6	36.5007	0.99	No Stat.	No Stat.
w	9	with drift no trend	7	38.8127	0.99	No Stat.	No Stat.
w	9	with drift no trend	8	40.9741	0.99	No Stat.	No Stat.
w	9	with drift no trend	9	43.4959	0.99	No Stat.	No Stat.
w	9	with drift and trend	1	15.2459	0.99	No Stat.	No Stat.
w	9	with drift and trend	2	21.306	0.99	No Stat.	No Stat.
W	9	with drift and trend	3	26.5082	0.99	No Stat.	No Stat.
w	9	with drift and trend	4	30.9558	0.99	No Stat.	No Stat.
w	9	with drift and trend	5	34.4187	0.99	No Stat.	No Stat.
w	9	with drift and trend	6	37.0336	0.99	No Stat.	No Stat.
w	9	with drift and trend	7	39.4714	0.99	No Stat.	No Stat.
w	9	with drift and trend	8	41.7807	0.99	No Stat.	No Stat.
rw	9	with drift and trend	9	44.5401	0.99	No Stat.	No Stat.
rw	10	no drift no trend	1	15.2068	0.99	No Stat.	No Stat.
	10	no drift no trend	2	21.1956	0.99	No Stat.	No Stat.
	10	no drift no trend	3	26.3129	0.99	No Stat.	No Stat.
	10	no drift no trend	4	30.6551	0.99	No Stat.	No Stat.
	10	no drift no trend	5	34.0132	0.99	No Stat.	No Stat.
	10	no drift no trend	6	36.5455	0.99	No Stat.	No Stat.
	10	no drift no trend	7	38.861	0.99	No Stat.	No Stat.
	10	no drift no trend	8	41.0263	0.99	No Stat.	No Stat.
	10	no drift no trend	9	43.5492	0.99	No Stat.	No Stat.
	10	no drift no trend	10	45.9555	0.99	No Stat.	No Stat.
	10	with drift no trend	1	15.19	0.99	No Stat.	No Stat.
	10	with drift no trend	2	21.172	0.99	No Stat.	No Stat.
	10	with drift no trend	3	26.2829	0.99	No Stat.	No Stat.
	10	with drift no trend	4	30.6192	0.99	No Stat.	No Stat.
	10	with drift no trend	5	33.9723	0.99	No Stat.	No Stat.
	10	with drift no trend	6	36.5007	0.99	No Stat.	No Stat.
	10	with drift no trend	7	38.8127	0.99	No Stat.	No Stat.
	10	with drift no trend	8	40.9741	0.99	No Stat.	No Stat.
	10	with drift no trend	9	43.4959	0.99	No Stat.	No Stat.
	10	with drift no trend	10	45.9005	0.99	No Stat.	No Stat.
	10	with drift and trend	10	15.2459	0.99	No Stat.	No Stat.
	10	with drift and trend	2	21.306	0.99	No Stat.	No Stat.
	10	with drift and trend		26.5082	0.99	No Stat.	No Stat.
		with drift and trend	3			No Stat. No Stat.	
	10		4	30.9558	0.99		No Stat.
	10	with drift and trend	5 6	34.4187	0.99	No Stat.	No Stat.
	10	with drift and trend	6	37.0336	0.99	No Stat.	No Stat.
	10	with drift and trend	7	39.4714	0.99	No Stat.	No Stat.
	10	with drift and trend	8	41.7807	0.99	No Stat.	No Stat.
	10	with drift and trend	9	44.5401	0.99	No Stat.	No Stat.
	10	with drift and trend	10	47.1528	0.99	No Stat.	No Stat.
	11	no drift no trend	1	15.2068	0.99	No Stat.	No Stat.
	11	no drift no trend	2	21.1956	0.99	No Stat.	No Stat.
	11	no drift no trend	3	26.3129	0.99	No Stat.	No Stat.
	11	no drift no trend	4	30.6551	0.99	No Stat.	No Stat.
	11	no drift no trend	5	34.0132	0.99	No Stat.	No Stat.
	11	no drift no trend	6	36.5455	0.99	No Stat.	No Stat.
rw	11	no drift no trend	7	38.861	0.99	No Stat.	No Stat.

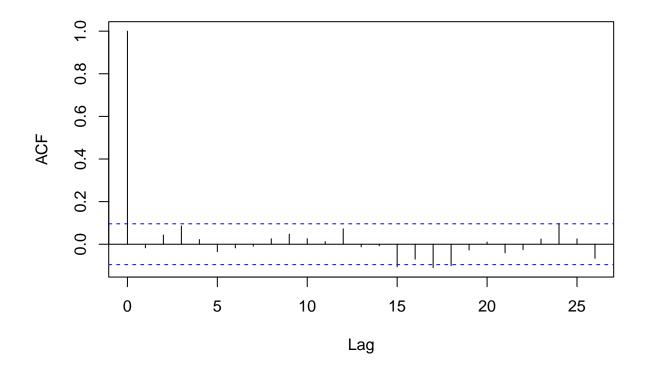
	N of lags	Type	lag	ADF	p.value	Stationary at 5%	Stationary at 10%
rw	11	no drift no trend	8	41.0263	0.99	No Stat.	No Stat.
rw	11	no drift no trend	9	43.5492	0.99	No Stat.	No Stat.
rw	11	no drift no trend	10	45.9555	0.99	No Stat.	No Stat.
rw	11	no drift no trend	11	47.5865	0.99	No Stat.	No Stat.
rw	11	with drift no trend	1	15.19	0.99	No Stat.	No Stat.
rw	11	with drift no trend	2	21.172	0.99	No Stat.	No Stat.
w	11	with drift no trend	3	26.2829	0.99	No Stat.	No Stat.
rw	11	with drift no trend	4	30.6192	0.99	No Stat.	No Stat.
w	11	with drift no trend	5	33.9723	0.99	No Stat.	No Stat.
rw	11	with drift no trend	6	36.5007	0.99	No Stat.	No Stat.
w	11	with drift no trend	7	38.8127	0.99	No Stat.	No Stat.
w	11	with drift no trend	8	40.9741	0.99	No Stat.	No Stat.
rw	11	with drift no trend	9	43.4959	0.99	No Stat.	No Stat.
rw	11	with drift no trend	10	45.9005	0.99	No Stat.	No Stat.
rw	11	with drift no trend	11	47.533	0.99	No Stat.	No Stat.
w	11	with drift and trend	1	15.2459	0.99	No Stat.	No Stat.
w	11	with drift and trend	2	21.306	0.99	No Stat.	No Stat.
w	11	with drift and trend	3	26.5082	0.99	No Stat.	No Stat.
w	11	with drift and trend	4	30.9558	0.99	No Stat.	No Stat.
w	11	with drift and trend	5	34.4187	0.99	No Stat.	No Stat.
rw	11	with drift and trend	6	37.0336	0.99	No Stat.	No Stat.
w	11	with drift and trend	7	39.4714	0.99	No Stat.	No Stat.
w	11	with drift and trend	8	41.7807	0.99	No Stat.	No Stat.
w	11	with drift and trend	9	44.5401	0.99	No Stat.	No Stat.
w	11	with drift and trend	10	47.1528	0.99	No Stat.	No Stat.
w	11	with drift and trend	11	48.9888	0.99	No Stat.	No Stat.
w	12	no drift no trend	1	15.2068	0.99	No Stat.	No Stat.
w	12	no drift no trend	2	21.1956	0.99	No Stat.	No Stat.
w	12	no drift no trend	3	26.3129	0.99	No Stat.	No Stat.
w	12	no drift no trend	4	30.6551	0.99	No Stat.	No Stat.
rw	12	no drift no trend	5	34.0132	0.99	No Stat.	No Stat.
rw	12	no drift no trend	6	36.5455	0.99	No Stat.	No Stat.
w	12	no drift no trend	7	38.861	0.99	No Stat.	No Stat.
w	12	no drift no trend	8	41.0263	0.99	No Stat.	No Stat.
rw	12	no drift no trend	9	43.5492	0.99	No Stat.	No Stat.
w	12	no drift no trend	10	45.9555	0.99	No Stat.	No Stat.
w	12	no drift no trend	11	47.5865	0.99	No Stat.	No Stat.
rw	12	no drift no trend	12	48.4854	0.99	No Stat.	No Stat.
w	12	with drift no trend	1	15.19	0.99	No Stat.	No Stat.
w	12	with drift no trend	2	21.172	0.99	No Stat.	No Stat.
w	12	with drift no trend	3	26.2829	0.99	No Stat.	No Stat.
rw	12	with drift no trend	4	30.6192	0.99	No Stat.	No Stat.
w	12	with drift no trend	5	33.9723	0.99	No Stat.	No Stat.
w	12	with drift no trend	6	36.5007	0.99	No Stat.	No Stat.
rw	12	with drift no trend	7	38.8127	0.99	No Stat.	No Stat.
·W	12	with drift no trend	8	40.9741	0.99	No Stat.	No Stat.
w	12	with drift no trend	9	43.4959	0.99	No Stat.	No Stat.
w	12	with drift no trend	10	45.9005	0.99	No Stat.	No Stat.
·W	12	with drift no trend	11	47.533	0.99	No Stat.	No Stat.
·W	12	with drift no trend	12	48.4345	0.99	No Stat.	No Stat.
w	12	with drift and trend	1	15.2459	0.99	No Stat.	No Stat.
	14	with and and tiend	т	10.4403	0.33	no biai.	in buau.

	N of lags	Type	lag	ADF	p.value	Stationary at 5%	Stationary at 10%
rw	12	with drift and trend	3	26.5082	0.99	No Stat.	No Stat.
rw	12	with drift and trend	4	30.9558	0.99	No Stat.	No Stat.
rw	12	with drift and trend	5	34.4187	0.99	No Stat.	No Stat.
rw	12	with drift and trend	6	37.0336	0.99	No Stat.	No Stat.
rw	12	with drift and trend	7	39.4714	0.99	No Stat.	No Stat.
rw	12	with drift and trend	8	41.7807	0.99	No Stat.	No Stat.
rw	12	with drift and trend	9	44.5401	0.99	No Stat.	No Stat.
rw	12	with drift and trend	10	47.1528	0.99	No Stat.	No Stat.
rw	12	with drift and trend	11	48.9888	0.99	No Stat.	No Stat.
rw	12	with drift and trend	12	50.0282	0.99	No Stat.	No Stat.

```
lag
"1"
##
                {\tt N} of lags
                                              Туре
                       "1" "with drift no trend"
##
##
                       ADF
                                          p.value
                                                         Stationary at 5%
                  "15.19"
                                            "0.99"
                                                                "No Stat."
##
##
       Stationary at 10%
               "No Stat."
##
## $`ADF Statistic using BIC`
## [1] -4.474052
```

Point 3

Series out\$residuals



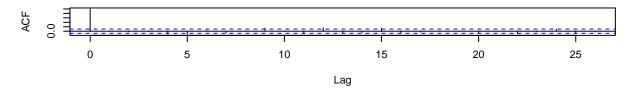
p q

Point 4

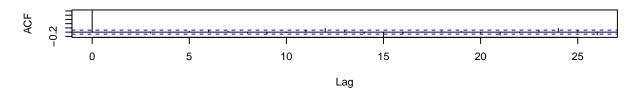
```
## Augmented Dickey-Fuller Test
## alternative: stationary
##
## Type 1: no drift no trend
        lag ADF p.value
          0 22.3
## [1,]
                     0.99
## [2,]
          1 32.7
                     0.99
## [3,]
          2 41.8
                     0.99
## [4,]
          3 50.3
                     0.99
          4 59.7
                     0.99
## [5,]
## [6,]
          5 66.9
                     0.99
## Type 2: with drift no trend
        lag ADF p.value
          0 22.3
## [1,]
                     0.99
## [2,]
          1 32.7
                     0.99
## [3,]
          2 41.9
                     0.99
## [4,]
          3 50.5
                     0.99
## [5,]
          4 60.1
                     0.99
## [6,]
          5 67.4
                     0.99
## Type 3: with drift and trend
        lag ADF p.value
          0 22.3
## [1,]
                     0.99
## [2,]
          1 32.7
                     0.99
## [3,]
          2 41.9
                     0.99
## [4,]
          3 50.5
                     0.99
          4 60.1
## [5,]
                     0.99
## [6,]
          5 67.5
                     0.99
## ----
## Note: in fact, p.value = 0.01 means p.value <= 0.01
## Augmented Dickey-Fuller Test
## alternative: stationary
##
## Type 1: no drift no trend
##
        lag ADF p.value
## [1,]
          0 2.47
                    0.990
## [2,]
          1 1.42
                    0.960
## [3,]
          2 1.60
                    0.973
          3 1.63
## [4,]
                    0.975
## [5,]
          4 1.56
                    0.970
## [6,]
          5 1.35
                    0.955
## Type 2: with drift no trend
##
        lag ADF p.value
## [1,]
          0 2.46
                     0.99
          1 1.41
                     0.99
## [2,]
## [3,]
          2 1.60
                     0.99
                     0.99
## [4,]
          3 1.63
## [5,]
          4 1.56
                     0.99
## [6,]
          5 1.35
                     0.99
## Type 3: with drift and trend
```

```
lag ADF p.value
## [1,]
          0 2.47
                    0.99
         1 1.42
                    0.99
## [2,]
## [3,]
          2 1.61
                    0.99
## [4,]
         3 1.64
                    0.99
## [5,]
          4 1.57
                    0.99
## [6,]
          5 1.36
                    0.99
## ----
## Note: in fact, p.value = 0.01 means p.value <= 0.01
## Augmented Dickey-Fuller Test
## alternative: stationary
##
## Type 1: no drift no trend
        lag ADF p.value
         0 1.852
## [1,]
                    0.984
## [2,]
        1 0.579
                    0.811
## [3,]
        2 0.886
                    0.899
## [4,]
        3 0.933
                    0.906
## [5,]
        4 1.072
                    0.923
## [6,]
        5 1.081
                    0.924
## Type 2: with drift no trend
        lag ADF p.value
## [1,]
         0 1.847
                    0.990
        1 0.579
## [2,]
                    0.989
## [3,]
         2 0.886
                    0.990
## [4,]
        3 0.933
                    0.990
## [5,]
         4 1.071
                    0.990
## [6,]
         5 1.081
                    0.990
## Type 3: with drift and trend
        lag ADF p.value
## [1,]
        0 2.137
                     0.99
## [2,]
         1 0.714
                     0.99
## [3,]
         2 1.070
                     0.99
## [4,]
         3 1.145
                     0.99
## [5,]
         4 1.313
                     0.99
          5 1.332
## [6,]
                     0.99
## ----
## Note: in fact, p.value = 0.01 means p.value <= 0.01
## AIC(n)
##
```

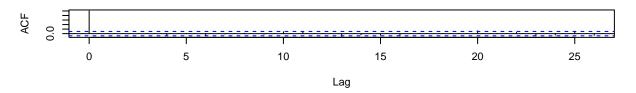
Series res[, 1]



Series res[, 2]



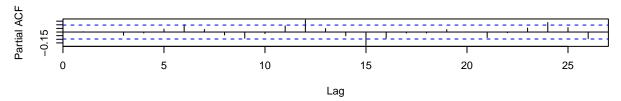
Series res[, 3]



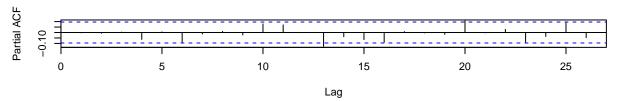
Series res[, 1]



Series res[, 2]



Series res[, 3]



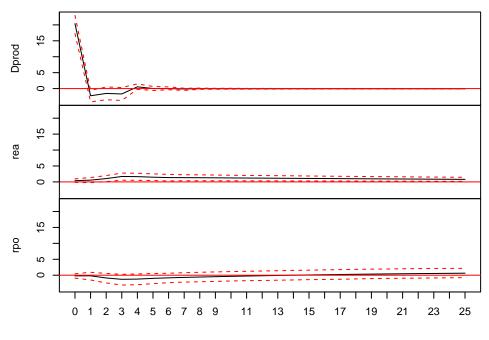
```
## Dprod rea rpo
## Dprod 416.145308 7.824951 -4.099590
## rea 7.824951 20.483391 1.765876
## rpo -4.099590 1.765876 38.132342

## Dprod rea rpo
## Dprod 1.00000000 0.08475361 -0.03254402
## rea 0.08475361 1.00000000 0.06318480
```

rpo -0.03254402 0.06318480 1.00000000 ## [1] 0.9701644 0.9701644 0.4696721 0.4634054 0.4634054 0.4593787 0.4593787

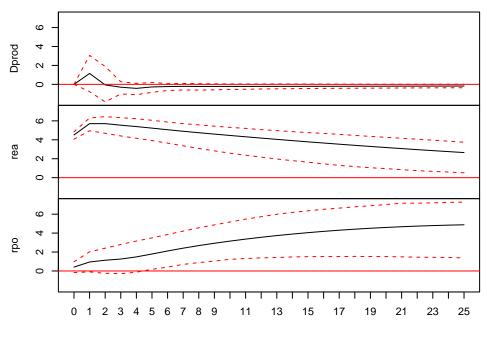
[8] 0.2924893 0.2924893

Orthogonal Impulse Response from Dprod



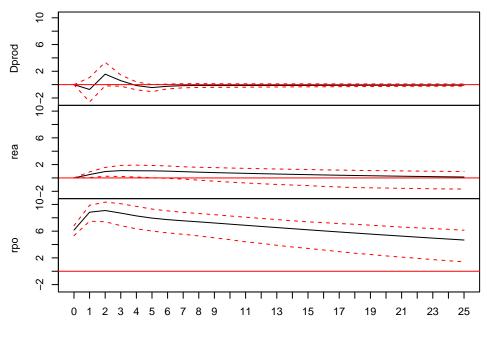
95 % Bootstrap CI, 1000 runs

Orthogonal Impulse Response from rea



95 % Bootstrap CI, 1000 runs

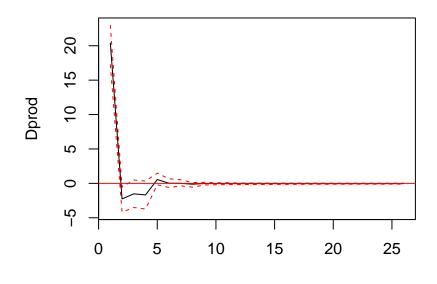
Orthogonal Impulse Response from rpo



95 % Bootstrap CI, 1000 runs

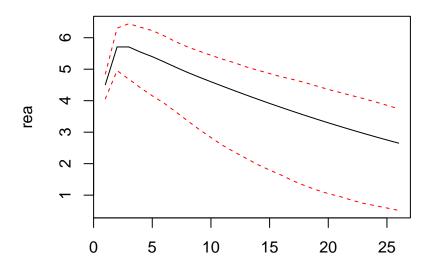
Point 5

Orthogonal Impulse Response from Dprod



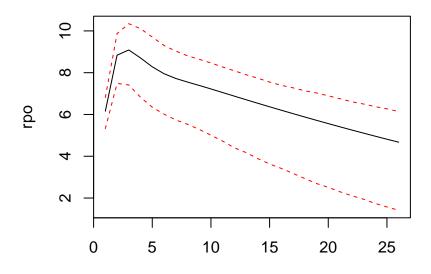
95 % Bootstrap CI, 1000 runs

Orthogonal Impulse Response from rea



95 % Bootstrap CI, 1000 runs

Orthogonal Impulse Response from rpo



95 % Bootstrap CI, 1000 runs