SSRMC Time Series Analysis

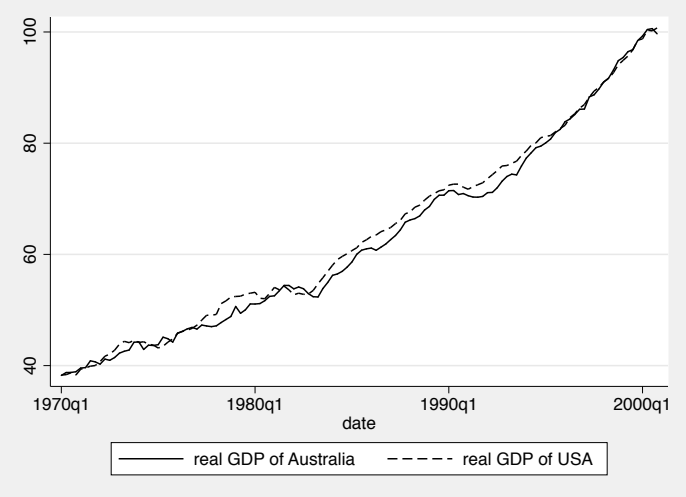
Topic Three: Vector Error Correction and Vector Autoregressive Models

STATA Codes and Outputs

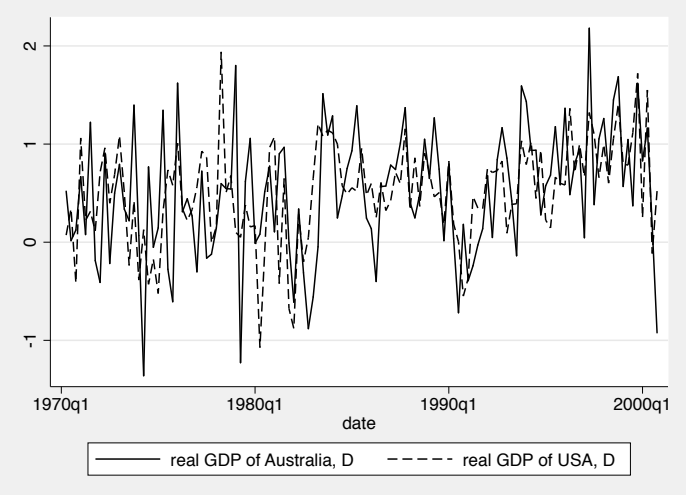
1. Estimating a VEC model (Slides 7 – 9)

```
use gdp, clear
gen date = q(1970q1) + _n-1
format %tq date
tsset date
```

```
tsline aus usa
```




```
tsline d.aus d.usa
```

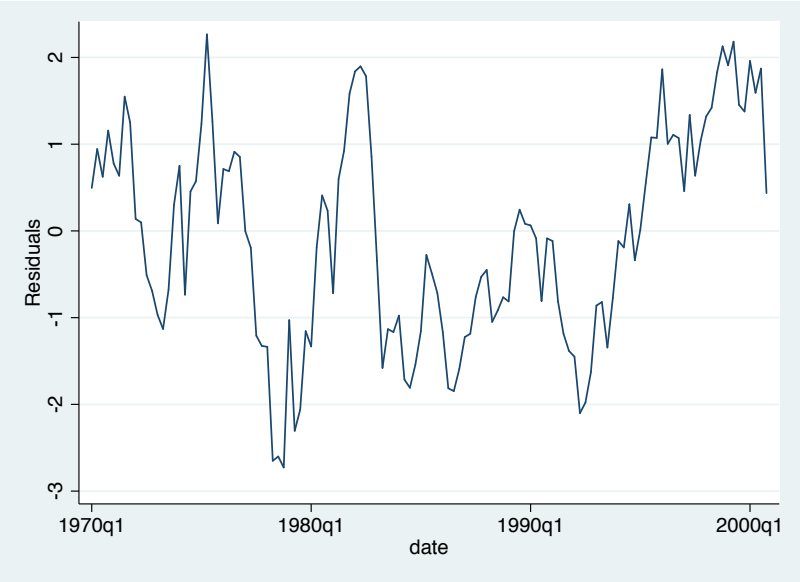


```
regress aus usa, noconst
```

Source	SS	df	MS	Number of obs	=	124
				F(1, 123)	>	99999.00
Model	526014.204	1	526014.204	Prob > F	=	0.0000
Residual	182.885542	123	1.48687433	R-squared	=	0.9997
				Adj R-squared	=	0.9996
Total	526197.09	124	4243.52492	Root MSE	=	1.2194

aus	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
usa	.9853495	.0016566	594.79	0.000	.9820703	.9886288

```
predict ehat, resi
tsline ehat
```




```
dfuller ehat, noconstant
```

Dickey-Fuller test for unit root — Number of obs = 123

	Test Statistic	Interpolated Dickey-Fuller 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-2.889	-2.597	-1.950	-1.612

```
varsoc aus usa
```

Selection-order criteria
Sample: 1971q1 - 2000q4 Number of obs = 120

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-701.045				420.59	11.7174	11.7363	11.7639
1	-182.615	1036.9*	4	0.000	.079488*	3.14359*	3.20019*	3.28296*
2	-178.91	7.4099	4	0.116	.079886	3.1485	3.24284	3.38079
3	-175.175	7.4695	4	0.113	.080253	3.15292	3.28499	3.47813
4	-171.657	7.0368	4	0.134	.080924	3.16095	3.33075	3.57907

Endogenous: aus usa
Exogenous: _cons

```
vec aus usa
```

Vector error-correction model

Sample: 1970q3 - 2000q4 Number of obs = 122
AIC = 3.165728
Log likelihood = -184.1094 HQIC = 3.249745
Det(Sigma_ml) = .0701186 SBIC = 3.372582

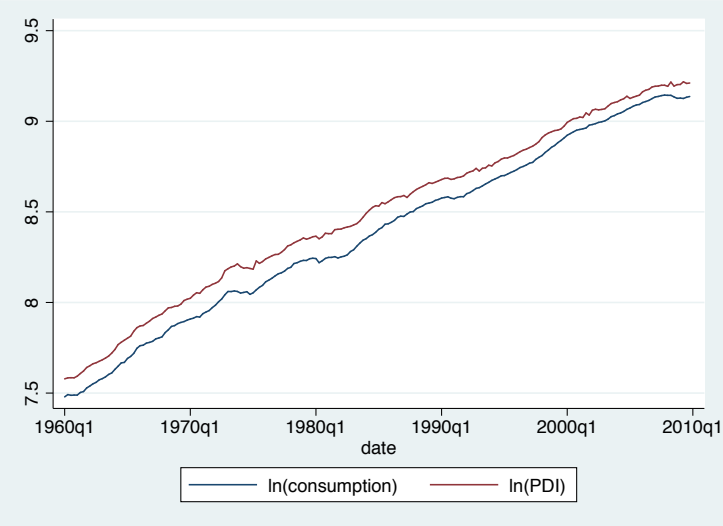
Equation	Parms	RMSE	R-sq	chi2	P>chi2
D_aus	4	.602421	0.4771	107.6622	0.0000
D_usa	4	.493404	0.5520	145.4073	0.0000

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
D_aus						
_ce1						
L1.	-.1280209	.0363718	-3.52	0.000	-.1993084	-.0567334
aus						
LD.	-.0021941	.0965246	-0.02	0.982	-.1913787	.1869906
usa						
LD.	.2064387	.1269826	1.63	0.104	-.0424427	.4553202
_cons	-.0646092	.135002	-0.48	0.632	-.3292083	.1999898
D_usa						
_ce1						
L1.	-.034953	.0297898	-1.17	0.241	-.09334	.023434
aus						
LD.	.0644926	.0790571	0.82	0.415	-.0904564	.2194416
usa						
LD.	.2281161	.1040033	2.19	0.028	.0242733	.4319589
_cons	.2366416	.1105715	2.14	0.032	.0199255	.4533577

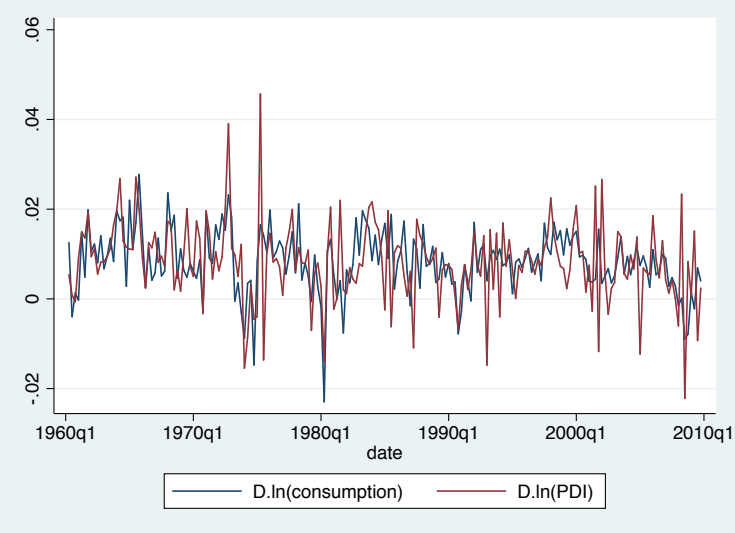
2. Estimating a VAR model (Slides 11 – 13)

```
use fred, clear
gen date = q(1960q1) + _n-1
format %tq date
tsset date
```

```
tsline c y, legend(lab (1 "ln(consumption)") lab(2 "ln(PDI)"))
```




```
tsline d.c d.y, legend(lab (1 "D.ln(consumption)") lab(2 "D.ln(PDI)"))
```




```
dfuller c, trend lags(3)
```

Augmented Dickey-Fuller test for unit root — Number of obs = **196**

	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
		Interpolated Dickey-Fuller		
Z(t)	**-2.977**	**-4.008**	**-3.437**	**-3.137**

MacKinnon approximate p-value for Z(t) = **0.1386**

```
dfuller y
```

Dickey-Fuller test for unit root Number of obs = 199

	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
		Interpolated Dickey-Fuller		
Z(t)	-2.741	-3.477	-2.883	-2.573

MacKinnon approximate p-value for Z(t) = 0.0673

```
dfuller d.c, lags(2)
```

Augmented Dickey-Fuller test for unit root Number of obs = 196

	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
		Interpolated Dickey-Fuller		
Z(t)	-5.045	-3.478	-2.884	-2.574

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

```
dfuller d.y
```

Dickey-Fuller test for unit root Number of obs = 198

	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
		Interpolated Dickey-Fuller		
Z(t)	-14.795	-3.477	-2.883	-2.573

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

```
reg c y
```

Source	SS	df	MS		
Model	47.8010807	1	47.8010807	Number of obs	= 200
				F(1, 198)	> 99999.00
Residual	.076689215	198	.000387319	Prob > F	= 0.0000
				R-squared	= 0.9984
				Adj R-squared	= 0.9984
Total	47.8777699	199	.240591808	Root MSE	= .01968

c	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
y	1.035288	.002947	351.30	0.000	1.029476	1.041099
_cons	-.4041628	.0250534	-16.13	0.000	-.4535685	-.354757

```
predict ehat, res
dfuller ehat, regress noconstant lags(1)
```

Augmented Dickey-Fuller test for unit root Number of obs = 198

	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
		Interpolated Dickey-Fuller		
Z(t)	-2.873	-2.587	-1.950	-1.617

Regression model	1%	5%	10%
(1) $y_t = \beta x_t + e_t$	−3.39	−2.76	−2.45
(2) $y_t = \beta_1 + \beta_2 x_t + e_t$	−3.96	−3.37	−3.07
(3) $y_t = \beta_1 + \delta t + \beta_2 x_t + e_t$	−3.98	−3.42	−3.13

Note: These critical values are taken from J. Hamilton (1994), *Time Series Analysis*, Princeton University Press, p. 766.

Critical value is -3.37. Do not reject the null hypothesis of unit root (i.e., the residual series is not stationary).

varsoc d.c d.y, maxlag(4)

Selection-order criteria
Sample: **1961q2 - 2009q4** Number of obs = **195**

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	1355.02				3.2e-09	-13.8772	-13.8636	-13.8436
1	1379.09	48.129	4	0.000	2.6e-09	-14.083	-14.0422*	-13.9823*
2	1383.92	9.6655*	4	0.046	2.6e-09	-14.0915	-14.0235	-13.9237
3	1388.24	8.6379	4	0.071	2.6e-09*	-14.0948*	-13.9996	-13.8598
4	1391.6	6.7149	4	0.152	2.6e-09	-14.0882	-13.9659	-13.7861

Endogenous: D.c D.y
Exogenous: _cons

varlmar

Lagrange-multiplier test

lag	chi2	df	Prob > chi2
1	9.5086	4	0.04957
2	5.6784	4	0.22449

H0: no autocorrelation at lag order

varbasic d.c d.y, lags(1/1) nograph

Vector autoregression

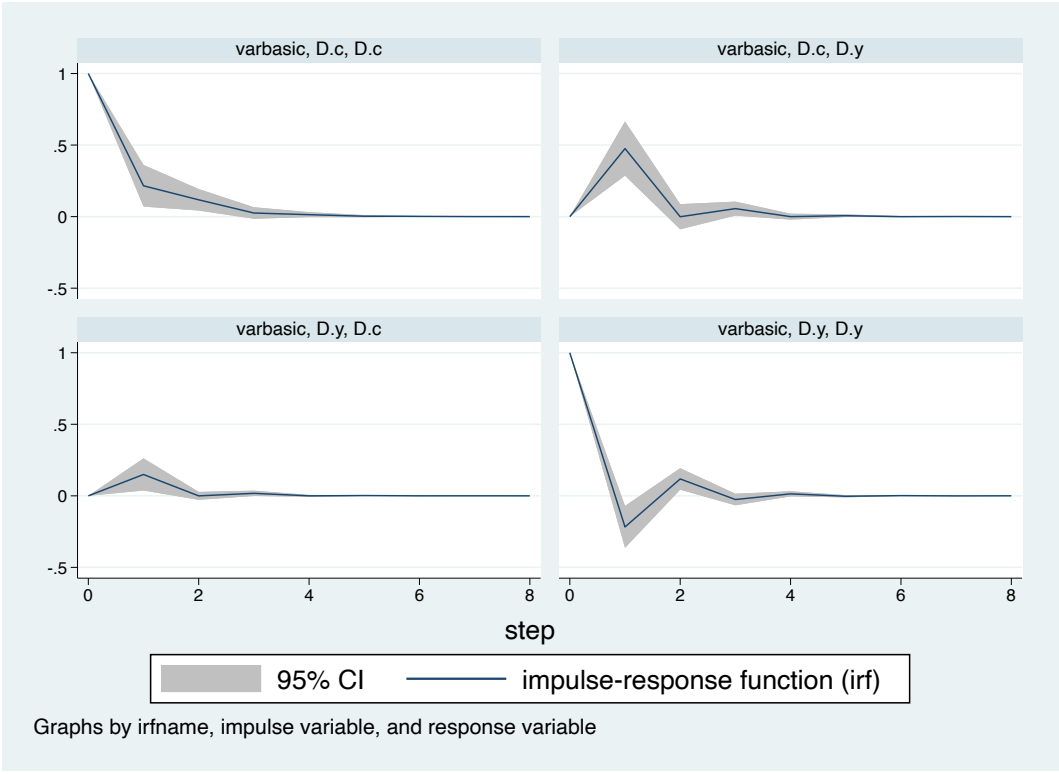
Sample: **1960q3 - 2009q4** Number of obs = **198**
Log likelihood = **1400.444** AIC = **-14.0853**
FPE = **2.62e-09** HQIC = **-14.04496**
Det(Sigma_ml) = **2.46e-09** SBIC = **-13.98565**

Equation	Parms	RMSE	R-sq	chi2	P>chi2
D_c	3	.006575	0.1205	27.12459	0.0000
D_y	3	.008562	0.1118	24.92656	0.0000

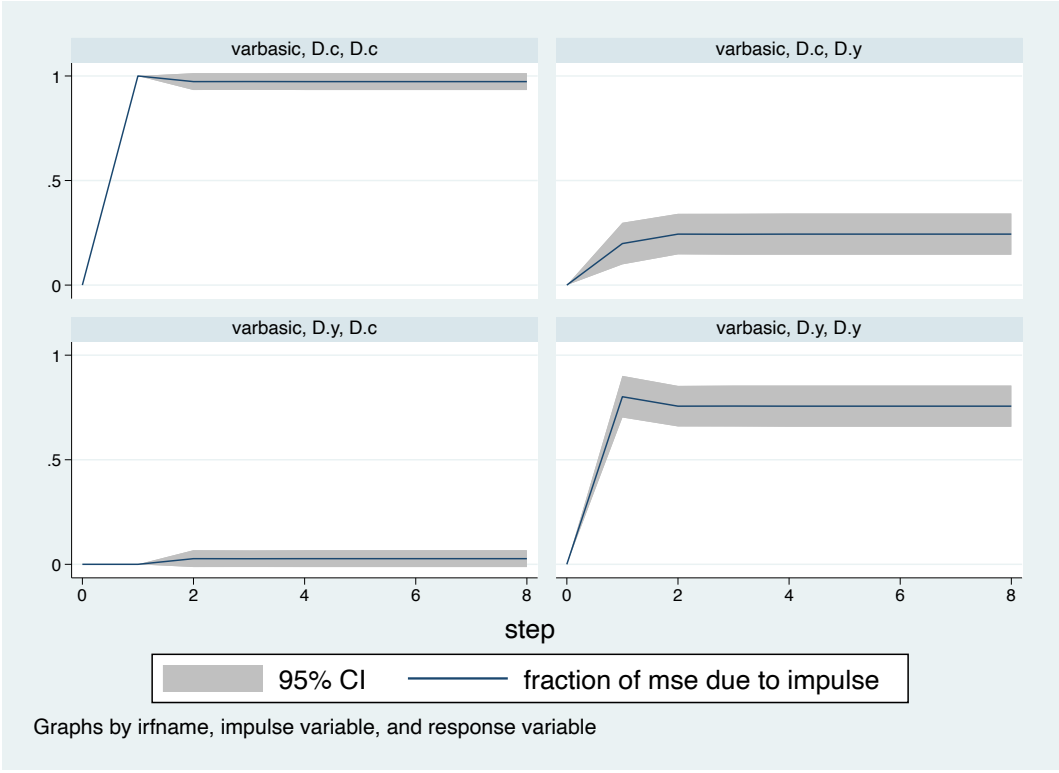
	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
D_c						
c						
LD.	.2156068	.0741801	2.91	0.004	.0702164	.3609972
y						
LD.	.1493798	.0572953	2.61	0.009	.0370832	.2616765
_cons	.0052776	.0007516	7.02	0.000	.0038046	.0067507
D_y						
c						
LD.	.4754276	.0965863	4.92	0.000	.286122	.6647332
y						
LD.	-.2171679	.0746013	-2.91	0.004	-.3633839	-.070952
_cons	.0060367	.0009786	6.17	0.000	.0041187	.0079547

3. Impulse Responses and Variance Decompositions (Slides 20 & 26)

```
irf graph irf
```




```
irf graph fevd
```



irf table irf

step	(1) irf	(1) Lower	(1) Upper	(2) irf	(2) Lower	(2) Upper
0	1	1	1	0	0	0
1	.215607	.070216	.360997	.475428	.286122	.664733
2	.117506	.042463	.192549	-.000742	-.088665	.087181
3	.025224	-.014994	.065442	.056027	.007234	.104819
4	.013808	-.003806	.031422	-.000175	-.020898	.020548
5	.002951	-.004713	.010615	.006603	-.002593	.015799
6	.001623	-.001478	.004723	-.000031	-.003694	.003632
7	.000345	-.000905	.001595	.000778	-.000719	.002275
8	.000191	-.000295	.000676	-4.9e-06	-.000581	.000571
9	.00004	-.000148	.000228	.000092	-.000134	.000317
10	.000022	-.000049	.000094	-7.2e-07	-.000086	.000084
11	4.7e-06	-.000022	.000032	.000011	-.000022	.000043
12	2.6e-06	-7.4e-06	.000013	-1.0e-07	-.000012	.000012

step	(3) irf	(3) Lower	(3) Upper	(4) irf	(4) Lower	(4) Upper
0	0	0	0	1	1	1
1	.14938	.037083	.261676	-.217168	-.363384	-.070952
2	-.000233	-.027858	.027392	.118181	.043031	.193332
3	.017604	-.000946	.036153	-.025776	-.066356	.014804
4	-.000055	-.006566	.006456	.013967	-.003818	.031752
5	.002075	-.001028	.005177	-.003059	-.010845	.004726
6	-9.7e-06	-.001161	.001141	.001651	-.001506	.004807
7	.000244	-.000241	.00073	-.000363	-.001642	.000916
8	-1.5e-06	-.000182	.000179	.000195	-.000303	.000693
9	.000029	-.000043	.000101	-.000043	-.000237	.000151
10	-2.2e-07	-.000027	.000026	.000023	-.000051	.000097
11	3.4e-06	-6.9e-06	.000014	-5.1e-06	-.000033	.000023
12	-3.2e-08	-3.8e-06	3.7e-06	2.7e-06	-7.7e-06	.000013

95% lower and upper bounds reported
(1) irfname = varbasic, impulse = D.c, and response = D.c
(2) irfname = varbasic, impulse = D.c, and response = D.y
(3) irfname = varbasic, impulse = D.y, and response = D.c
(4) irfname = varbasic, impulse = D.y, and response = D.y

irf table fevd

step	(1) fevd	(1) Lower	(1) Upper	(2) fevd	(2) Lower	(2) Upper
0	0	0	0	0	0	0
1	1	1	1	.198552	.099067	.298037
2	.97297	.932729	1.01321	.2438	.146908	.340692
3	.973298	.933619	1.01298	.243198	.145308	.341087
4	.972967	.93271	1.01322	.243752	.145393	.34211
5	.972972	.932723	1.01322	.243743	.145351	.342135
6	.972967	.932709	1.01323	.24375	.145347	.342153
7	.972967	.932709	1.01323	.24375	.145346	.342154
8	.972967	.932709	1.01323	.24375	.145346	.342154
9	.972967	.932709	1.01323	.24375	.145346	.342154
10	.972967	.932709	1.01323	.24375	.145346	.342154
11	.972967	.932709	1.01323	.24375	.145346	.342154
12	.972967	.932709	1.01323	.24375	.145346	.342154

step	(3) fevd	(3) Lower	(3) Upper	(4) fevd	(4) Lower	(4) Upper
0	0	0	0	0	0	0
1	0	0	0	.801448	.701963	.900933
2	.02703	-.013212	.067271	.7562	.659308	.853092
3	.026702	-.012977	.066381	.756802	.658913	.854692
4	.027033	-.013225	.06729	.756248	.65789	.854607
5	.027028	-.01322	.067277	.756257	.657865	.854649
6	.027033	-.013225	.067291	.75625	.657847	.854653
7	.027033	-.013225	.067291	.75625	.657846	.854654
8	.027033	-.013225	.067291	.75625	.657846	.854654
9	.027033	-.013225	.067291	.75625	.657846	.854654
10	.027033	-.013225	.067291	.75625	.657846	.854654
11	.027033	-.013225	.067291	.75625	.657846	.854654
12	.027033	-.013225	.067291	.75625	.657846	.854654

95% lower and upper bounds reported
(1) irfname = varbasic, impulse = D.c, and response = D.c
(2) irfname = varbasic, impulse = D.c, and response = D.y
(3) irfname = varbasic, impulse = D.y, and response = D.c
(4) irfname = varbasic, impulse = D.y, and response = D.y