ECONOMICS

INVESTMENT AND TECHNICAL PROGRESS IN THE G7 COUNTRIES AND AUSTRALIA

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DISCUSSION PAPER 11.10

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Abstract:

The vintage model of capital accumulation predicts that technical progress depends on the installation of new capital equipment. In this paper it is found that investment raises labor productivity in the G7 countries and Australia. This finding implies that the decline in investment during the global financial crisis will have a long lasting detrimental effect on labor productivity and hence wages.

Standard macroeconomic models imply that economic growth can be achieved either through capital accumulation or technical progress. Capital accumulation produces an ascending movement along the neoclassical production function and technical progress shifts the production function upwards. In growth accounting capital accumulation and technical progress are also viewed as independent sources of economic growth. Technical progress is the residual of output growth that cannot be explained by the growth in input factors, including among others capital. Yet, the widely accepted dichotomy between capital accumulation and technical progress as distinct sources of economic growth does not do justice to the diffusion of technology in the process of economic growth and development. Half a century ago, Johansen (1959), Salter (1955/1960), Solow (1960), and Kaldor and Mirrlees (1962) recognized that capital accumulation and technical progress are closely associated in the process of economic growth. Capital accumulation is a prerequisite for technical progress because, as Johansen put it, "new production techniques can be introduced only by means of new capital equipment." The idea that technical progress requires investment in new capital equipment to become effective is the cornerstone of the vintage model of capital accumulation. Since the business cycle is driven by changes in investment expenditure, an important prediction of the vintage model is that technical progress is cyclical.

As the vintage model of capital accumulation plays only a peripheral role in contemporary macroeconomics thinking, it is worthwhile to consider its origin and elaborate briefly on it. Writing his Ph.D. thesis at the University of Cambridge, W.E.G. Salter was the first to work seriously on the vintage model of capital accumulation.[1] He submitted his Ph.D. thesis in 1955 and he published *Productivity and Technical Change*, which builds on his

[1] Weber (2011) discusses Salter's contributions to production theory and international trade theory.

Ph.D. thesis, in 1960. Niehans (1993) opined that progress in economic theory follows a deterministic process because it is propelled by a drive for internal consistency. Each step is determined by the steps preceding it but creative minds can speed up the advance in economic theory along the largely preset path. Salter undoubtedly was a creative economist who advanced the understanding of the process of technical progress but the vintage model of capital accumulation would also have been discovered without him, albeit at a slower pace. Both Johansen (1959, 1961) and Solow (1960) appear to have discovered the vintage model independently of Salter – Solow refers to Johansen but neither of them mentions Salter – and also Kaldor (1957) and Kaldor and Mirrlees (1962) worked independently on it.

In the opening chapter of *Productivity and Technical Change*, Salter (1960) observes that actual labor productivity lags behind best-practice productivity in the manufacturing industry. There is a delay in the adoption of new technology because it is worthwhile to use old machines as long as they earn a surplus over operating costs. Old machines can compete with new machines because old machines need only to cover operating costs, whereas the decision to install a new machine depends on its operating costs and capital costs. The capital costs of old machines are no longer relevant in the production decision because 'bygones are forever bygones'. Salter's vintage model of capital accumulation explains why different vintages of capital coexist side-by-side in industrial countries and – even more so – in developing ones where it is often difficult to find finance for the capital cost of new equipment. For the purpose of this article, the essential insight is that gross investment determines the speed at which new technology is adopted in the production process.

> "Without gross investment, improving technology that requires new capital equipment simply represents a potential for higher productivity; to realize this potential requires gross investment. An economy with a low rate of gross investment is restricted in the rate at which new techniques can be brought into use; an economy with a high rate of gross investment can quickly bring new methods into use, and thus realize the benefits of improving technology. In this way, the rate

> of gross investment is a vital determinant of the extent to which observed productivity lags behind best-practice productivity." (Salter 1960, pp. 63-64)

To begin with, Solow (1960) considers a Cobb-Douglas production function with a technical shift factor:

$$Q(t) = A(t)L(t)^{\alpha} K(t)^{1-\alpha} \qquad (1)$$

Here, $L(t)$ and $K(t)$ measure the inputs of labor and physical capital at time t, and $Q(t)$ is output. An increase in total factor productivity $A(t)$ shifts the production function upwards over time. Solow comments that in the Cobb-Douglas production function technical progress is "peculiarly disembodied". The technical dimension of capital goods is perfectly malleable because no distinction is made between old and new capital goods. Therefore, all capital goods participate equally in technical progress – even museum pieces! Solow then puts forward the opposite viewpoint that capital goods of a certain vintage embody a fixed level of technology that cannot be changed at a later date. In this situation, the diffusion of technical progress requires the installation of new machinery that replaces obsolete equipment.

> "The striking assumption is that old and new capital equipment participate equally in technical change. This conflicts with the casual observation that many if not most innovations need to be embodied in new kinds of durable equipment before they can be made effective. Improvements in technology affect output only to the extent that they are carried into practice either by net capital formation or by the replacement of old-fashioned equipment with the latest models, with a consequent shift in the distribution of equipment by date of birth." (Solow 1960, p. 91)

The discovery of the vintage model of capital accumulation coincided with a shift from consumption to the production of armaments during World War II, which created favorable conditions for research in production theory. The activity analysis of Koopmans (1951a,b; 1957) would have provided an excellent starting point for the analysis of technical progress. In fact, Salter (1960, pp. 13-16) employs activity analysis in an informal way. There is no

reason to believe that technical progress affects economic activities evenly across the economy. However, it took almost two decades until Atkinson and Stiglitz (1969) pointed out that technical progress produces an uneven upward-shift of the neoclassical production function, possibly affecting only a single point or activity on it. This long delay proves Niehans right: it requires creativity to make the next predetermined step in the largely deterministic process of scientific discovery in economics. The evolution of economic theory also includes many instances in which theories fell into oblivion, only to be rediscovered at a later date. Ricardian equivalence provides a famous example – the vintage model of capital accumulation is another. In the 1970s and 80s, the emphasis in macroeconomic research shifted back to consumption and the standard view on disembodied technical progress prevailed in growth theory. The vintage model of capital accumulation, which played no role in the development of endogenous growth models in the 1980s, did not live up to its potential until it was revived by Hulten (1992), Cooley et al. (1997) and Greenwood et al. (1997) in the 1990s.

This article deals with the empirical side of the vintage model of capital accumulation. Since technical progress is embodied in new machinery and equipment, the vintage model predicts that an increase in gross investment will lead to a long lasting improvement in labor productivity. Both the replacement of worn out machinery and the expansion of production facilities create opportunities to install new technology. The empirical analysis focuses on labor productivity because the vintage model does not support the notion of total factor productivity, which presumes disembodied technical progress. Salter (1960, p. 36) reasons that technical progress "raises the productivity of labour in two stages: the first is the direct effect of technical advances in each industry; and the second is the substitution of capital for labour, following upon the cheapening of capital goods relative to wages." The price of

capital goods falls relative to labor because technical progress makes it possible to produce commodities – including capital goods – with less labor and capital.

Decomposition of Forecast-Error-Variances

The empirical analysis is based on VAR models that include gross investment, aggregate output (GDP) and output per worker. Eight models with three variables and two lags are estimated using annual data for the G7 countries and Australia from 1950 to 2009.[2] Following the original VAR methodology, which has never been abandoned by Sims (1980) and Doan (2007, p. 343), the logarithm of all variables is used because they grow exponentially but they are neither differenced nor detrended. The point is that it is important to preserve long-term relationships between variables because it may take some time until the full effect of investment on productivity is felt.[3] In VAR models the identification of variable specific innovations requires an assumption on the causal structure of the contemporaneous correlation matrix of innovations. Here, it is assumed that the contemporaneous correlation between variable specific shocks represents a causal chain that runs from investment to GDP and to labor productivity. The effect of investment on GDP is suggested by the Keynesian multiplier, and the effect of GDP on labor productivity may reflect labor hoarding. The effect of investment on labor productivity, which arises in the vintage model of capital accumulation, is the main interest of this study. It should be noted that every VAR model is structural because the identification of variable specific shocks requires economic theory.

[2] Germany 1970-2009. The data are from the Penn World Table 7.0. Real GDP was constructed by multiplying real GDP per capita with population and investment equals 'investment share of real GDP per capita' times real GDP per capita.

[3] The Johanson procedure indicates that variables are not cointegrated in most countries. All econometric work is included in an appendix of Economics Discussion Paper 11.10, Business School, University of Western Australia (available on SSRN, RePEc and the website of the UWA Business School). See Enders (2010, p. 303) for the continuing use of non-stationary VARs and Mills and Markellos (2008, pp. 375-378) for the impulse response asymptotics.

The moving-average representation of a VAR model can be written in two ways, as decompositions of forecast-error-variances and as impulse responses. In this section, the forecast-error-variances for labor productivity are decomposed into the innovations experienced by each variable during the forecasting period. Labor productivity moves independently if its *k*-step ahead forecast-error-variances are caused by its own innovations, while labor productivity depends on other variables if most of the forecast-error-variances arise from shocks to those variables. In Table 1 the decomposition of the forecast-error-variances is read along the rows, which add up to 100. For example, 49.3% of the 10-year ahead forecast-error-variance of Australian labor productivity is explained by shocks to investment, 43.3% by shocks to GDP and only 7.4% by shocks to labor productivity itself. Thus, Australian labor productivity is an endogenous variable that strongly depends on investment and GDP. The same pattern emerges in the other countries. At a forecasting horizon of 15 to 20 years, unforeseen investment shocks account for more than 80% of the forecast-error-variances in France and Japan; the share of investment lies between about 30% and 60% in Germany, the United Kingdom, Italy and the USA; and it is less than 10% only in Canada. The large contributions of investment to the forecast-error-variances, which are found in Table 1, support the prediction of the vintage model of capital accumulation that investment is an important determinant of labor productivity.

In this section, it has been established that labor productivity depends strongly on investment in the G7 countries and Australia, except in Canada. The impulse response functions, which will be shown in the next section, confirm that – as implied by the vintage model of capital accumulation – investment in new capital goods has a long lasting positive effect on labor productivity.

Table 1. Decomposition of Forecast-Error-Variances for Labor Productivity

Year	*Investment*	*GDP*	*Labor Productivity*
	Australia		
5	46.2	43.8	10.0
10	49.3	43.3	7.4
15	51.2	41.9	6.9
20	52.4	40.7	6.9
	Canada		
5	10.4	59.6	30.0
10	8.2	63.9	27.9
15	8.0	66.2	25.7
20	8.1	67.6	24.3
	France		
5	77.5	13.5	9.0
10	82.5	8.3	9.2
15	84.3	6.4	9.3
20	85.1	5.4	9.6
	Germany		
5	59.9	19.4	20.6
10	43.4	24.9	31.7
15	40.8	29.9	29.3
20	39.4	32.6	28.0
	Italy		
5	33.1	40.3	26.5
10	44.9	32.8	22.2
15	52.5	28.3	19.2
20	56.5	26.1	17.4
	Japan		
5	59.3	20.6	20.2
10	76.1	11.8	12.1
15	84.3	8.1	7.5
20	87.8	6.5	5.8
	United Kingdom		
5	30.1	47.0	22.9
10	30.6	51.5	17.9
15	30.4	55.1	14.5
20	29.8	57.6	12.6
	USA		
5	42.7	31.0	26.3
10	40.9	26.8	32.3
15	41.3	26.2	32.5
20	42.0	26.9	31.2

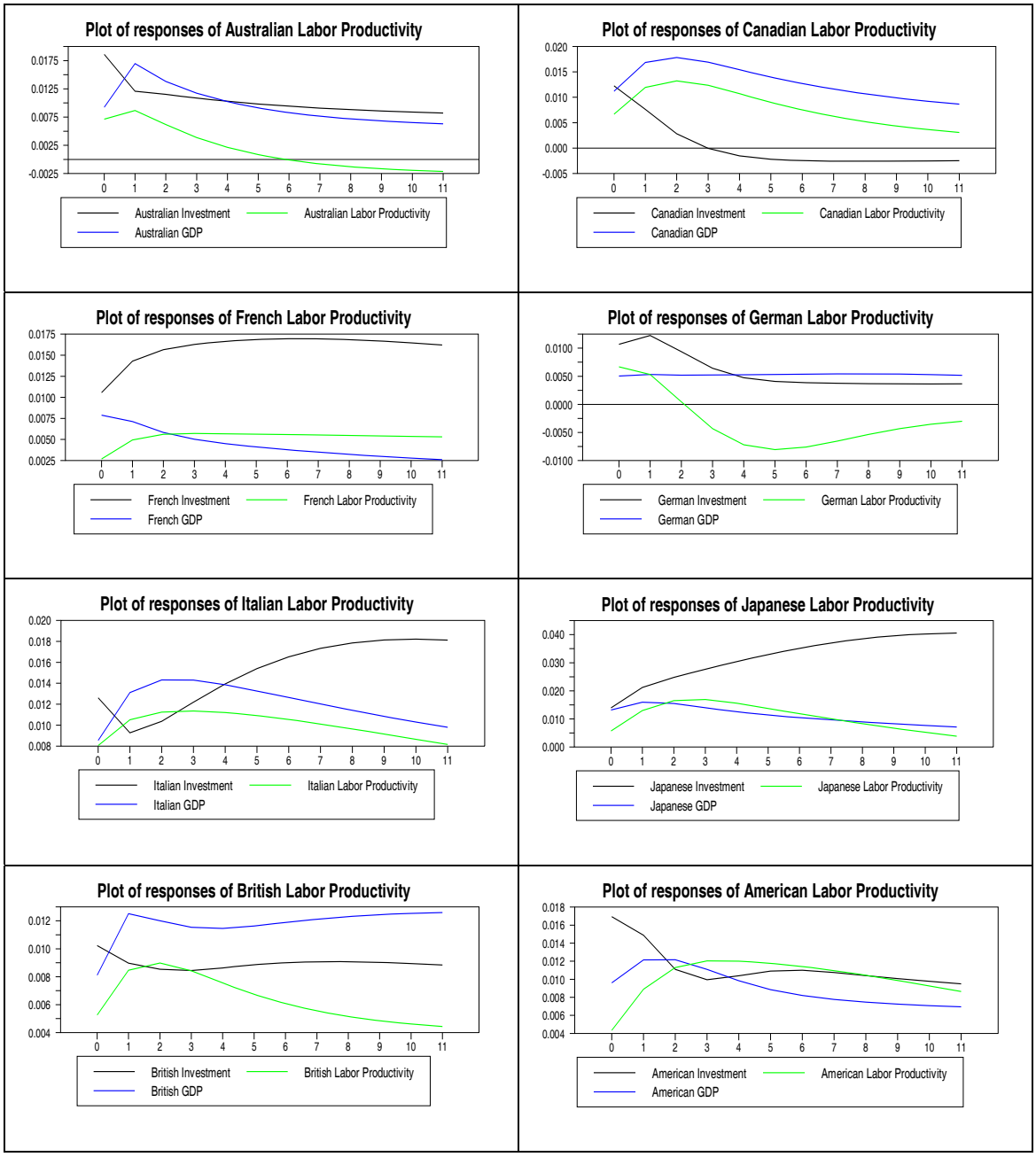
Impulse Responses

Figure 1 displays the responses of labor productivity to investment shocks in the G7 countries and Australia. The investment shocks are temporary, lasting a single year, and their size equals one standard deviation of the residuals of the investment equation for each country. Accordingly, the investment shocks range from 4.9% in Germany to 10.2% in Australia, with the other countries lying between these limits.[4] The responses in labor productivity are plotted over 12 years along the lower axis and, since variables are logarithmic, the impulse responses are measured as percentage changes along the upper axis, using continuous growth compounding.

In Australia a temporary shock to investment immediately raises labor productivity by 1.8% and the productivity gain settles at 0.8% after about 10 years. The effect of investment on labor productivity is strongest in Japan and weakest in Canada. In Japan a shock to investment immediately raises productivity by 1.4% and the full effect of the investment shock is felt after about ten years, when the productivity gain reaches 4%. In all countries productivity responds positively to investment, both in the short-term and long-term, except for Canada where it rises only in the short-term. The positive impulse responses of labor productivity to investment shocks are meaningful because, as shown by the decompositions of forecast-error-variances in Table 1, investment accounts for a large share of the variation in labor productivity in all countries, except in Canada. As predicted by the vintage model of capital accumulation, a temporary increase in investment gives rise to a long lasting increase in labor productivity because investment creates opportunities to catch up with best practice productivity by installing new technology.

[4] The standard errors of the estimated investment equations are: Australia (10.2%), Canada (7.9%), France (6.5%), Germany (4.9%), Italy (7.2%), Japan (7.7%), United Kingdom (7.4%) and United States (7.3%).

Figure 1. Responses of Labor Productivity in the G7 Countries and Australia



Besides the response of labor productivity to an investment shock, Figure 1 also displays the responses of productivity to GDP and to its own shocks. In all countries, a positive (negative) shock to GDP is followed by an increase (fall) in labor productivity, which may be explained by labor hoarding. Finally, the Keynesian multiplier prevails as an increase in investment raises GDP in all countries and there is evidence for an accelerator effect of GDP on investment in some countries (impulse responses not shown).[5]

Conclusion

One goal of this article was to unearth the origins of the vintage model of capital accumulation, which are not well known. The vintage model was independently discovered by Johansen (1959, 1961), Salter (1955/1960), Solow (1960), Kaldor (1957) and Kaldor and Mirrlees (1962), and it was rediscovered by Hulten (1992), Cooley et al. (1997) and Greenwood et al. (1997). The second goal was to demonstrate the empirical relevance of the vintage model. It was found that the dynamic interaction between investment, aggregate output and labor productivity supports the prediction of the vintage model that an increase in investment produces a long lasting improvement in labor productivity.

The vintage model of capital accumulation is still awaiting widespread application in macroeconomic analysis that would be commensurate with its significance. Indeed, the vintage model is of particular relevance in the current economic situation. Since investment is required for technical progress, the decline in investment during the global financial crisis will have a long lasting detrimental effect on labor productivity and hence wages in many countries.

[5] A VAR model with three variables produces nine impulse response functions, which gives 72 impulse response functions for eight countries.

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Econometric Work

This appendix includes the estimated log-level VARS and VECMs.

A) Log-Level VARs

This section uses the program IMPULSES.PRG of RATS 7.2 (RATS User's Manual, Example 10.3).

```
* Australia
* ________

* Use Clear Program!

calendar(a) 1950
open data

* Penn 7 G7 col a.xls

data(format=xls,org=columns) / popaus rgdpchaus kiaus rgdpwokaus

set rgdpaus = rgdpchaus*popaus
set investaus = kiaus*rgdpaus

set lnrgdpaus = log(rgdpaus)
set lninvestaus = log(investaus)
set lnlaborpwaus = log(rgdpwokaus)

graph(key=upleft) 1
# lnrgdpaus
graph(key=upleft) 1
# lninvestaus
graph(key=upleft) 1
# lnlaborpwaus

compute  neqn   = 3
compute  nlags  = 2
compute  nsteps = 12

grparm(nopatterns)
grparm(bold) header 36
grparm axislabeling 27
grparm keylabeling 27

system(model=ausmodel)
variables lninvestaus lnrgdpaus lnlaborpwaus
lags 1 to nlags
det constant
end(system)

estimate(cvout=vaus)

VAR/System - Estimation by Least Squares
```

Dependent Variable LNINVESTAUS
Annual Data From 1952:01 To 2007:01
Usable Observations 56 Degrees of Freedom 49
Mean of Dependent Variable 22.619144473
Std Error of Dependent Variable 0.678313468
Standard Error of Estimate 0.102463436
Sum of Squared Residuals 0.5144390315
Durbin-Watson Statistic 1.596253

Variable	Coeff	Std Error	T-Stat	Signif
1. LNINVESTAUS{1}	-0.294435999	0.262430891	-1.12196	0.26734899
2. LNINVESTAUS{2}	0.822657267	0.257912486	3.18968	0.00248433
3. LNRGDPAUS{1}	2.911846911	2.208487859	1.31848	0.19347285
4. LNRGDPAUS{2}	-2.806668840	2.124633909	-1.32101	0.19263314
5. LNLABORPWAUS{1}	1.840591529	1.898342355	0.96958	0.33701850
6. LNLABORPWAUS{2}	-0.930889029	1.885922166	-0.49360	0.62379476
7. Constant	-1.194425099	1.164361610	-1.02582	0.31001421

F-Tests, Dependent Variable LNINVESTAUS

Variable	F-Statistic	Signif
LNINVESTAUS	6.0473	0.0044952
LNRGDPAUS	0.8750	0.4232542
LNLABORPWAUS	0.8461	0.4352699

Dependent Variable LNRGDPAUS
Annual Data From 1952:01 To 2007:01
Usable Observations 56 Degrees of Freedom 49
Mean of Dependent Variable 19.517348909
Std Error of Dependent Variable 0.622469495
Standard Error of Estimate 0.022361522
Sum of Squared Residuals 0.0245018447
Durbin-Watson Statistic 1.837545

Variable	Coeff	Std Error	T-Stat	Signif
1. LNINVESTAUS{1}	-0.239238847	0.057272665	-4.17719	0.00012091
2. LNINVESTAUS{2}	0.206556879	0.056286572	3.66974	0.00059879
3. LNRGDPAUS{1}	1.730833679	0.481978262	3.59110	0.00076093
4. LNRGDPAUS{2}	-0.689467614	0.463678057	-1.48695	0.14343409
5. LNLABORPWAUS{1}	0.231701410	0.414292406	0.55927	0.57852475
6. LNLABORPWAUS{2}	-0.246484665	0.411581836	-0.59887	0.55201727
7. Constant	0.107035809	0.254109156	0.42122	0.67543658

F-Tests, Dependent Variable LNRGDPAUS

Variable	F-Statistic	Signif
LNINVESTAUS	9.3977	0.0003511
LNRGDPAUS	124.1011	0.0000000
LNLABORPWAUS	0.1804	0.8354664

Dependent Variable LNLABORPWAUS
Annual Data From 1952:01 To 2007:01
Usable Observations 56 Degrees of Freedom 49
Mean of Dependent Variable 10.736281655
Std Error of Dependent Variable 0.293666127

Standard Error of Estimate	0.023463688
Sum of Squared Residuals	0.0269766881
Durbin-Watson Statistic	1.912711

Variable	Coeff	Std Error	T-Stat	Signif
1. LNINVESTAUS{1}	-0.226529717	0.060095550	-3.76949	0.00044033
2. LNINVESTAUS{2}	0.186532208	0.059060855	3.15831	0.00271677
3. LNRGDPAUS{1}	0.598337509	0.505734260	1.18311	0.24247551
4. LNRGDPAUS{2}	-0.497854442	0.486532065	-1.02327	0.31120493
5. LNLABORPWAUS{1}	1.217935074	0.434712268	2.80170	0.00725868
6. LNLABORPWAUS{2}	-0.338486696	0.431868098	-0.78377	0.43694548
7. Constant	0.239319635	0.266633821	0.89756	0.37380969

F-Tests, Dependent Variable LNLABORPWAUS

Variable	F-Statistic	Signif
LNINVESTAUS	7.4572	0.0014881
LNRGDPAUS	1.3087	0.2794429
LNLABORPWAUS	11.8347	0.0000641

errors(model=ausmodel,steps=24,cv=vaus)

Decomposition of Variance for Series LNINVESTAUS

Step	Std Error	LNINVESTAUS	LNRGDPAUS	LNLABORPWAUS
1	0.09584577	100.000	0.000	0.000
2	0.12242739	85.481	13.376	1.143
3	0.13896128	81.109	17.458	1.433
4	0.15029546	79.233	19.365	1.402
5	0.15857057	78.219	20.479	1.301
6	0.16489685	77.583	21.211	1.206
7	0.16991688	77.130	21.731	1.139
8	0.17402820	76.772	22.126	1.101
9	0.17748846	76.468	22.441	1.091
10	0.18047063	76.194	22.702	1.104
11	0.18309420	75.940	22.927	1.134
12	0.18544365	75.699	23.125	1.177
13	0.18758002	75.468	23.302	1.230
14	0.18954813	75.245	23.465	1.290
15	0.19138145	75.029	23.616	1.356
16	0.19310531	74.819	23.757	1.424
17	0.19473912	74.616	23.890	1.494
18	0.19629791	74.418	24.016	1.566
19	0.19779342	74.226	24.137	1.637
20	0.19923493	74.039	24.252	1.709
21	0.20062981	73.858	24.363	1.779
22	0.20198396	73.682	24.469	1.849
23	0.20330213	73.511	24.572	1.917
24	0.20458819	73.345	24.671	1.984

Decomposition of Variance for Series LNRGDPAUS

Step	Std Error	LNINVESTAUS	LNRGDPAUS	LNLABORPWAUS
1	0.02091729	79.208	20.792	0.000
2	0.03119292	54.628	45.093	0.279
3	0.03814126	50.615	49.199	0.187
4	0.04371769	49.910	49.807	0.283

5	0.04854194	50.109	49.320	0.571
6	0.05288082	50.597	48.430	0.974
7	0.05687217	51.162	47.415	1.424
8	0.06059534	51.722	46.399	1.879
9	0.06410014	52.248	45.437	2.315
10	0.06742023	52.729	44.551	2.720
11	0.07057984	53.163	43.748	3.089
12	0.07359735	53.554	43.025	3.421
13	0.07648731	53.905	42.377	3.718
14	0.07926159	54.221	41.796	3.983
15	0.08193014	54.505	41.275	4.220
16	0.08450149	54.761	40.807	4.432
17	0.08698299	54.993	40.386	4.621
18	0.08938113	55.203	40.006	4.791
19	0.09170163	55.394	39.662	4.944
20	0.09394960	55.568	39.350	5.082
21	0.09612963	55.727	39.066	5.207
22	0.09824585	55.873	38.807	5.320
23	0.10030202	56.007	38.569	5.424
24	0.10230155	56.131	38.350	5.519

Decomposition of Variance for Series LNLABORPWAUS

Step	Std Error	LNINVESTAUS	LNRGDPAUS	LNLABORPWAUS
1	0.02194827	71.787	17.715	10.498
2	0.03146648	49.654	37.663	12.684
3	0.03675722	46.211	41.683	12.106
4	0.04026594	45.801	43.195	11.004
5	0.04285280	46.207	43.832	9.961
6	0.04490446	46.855	44.038	9.107
7	0.04662118	47.544	44.007	8.449
8	0.04811517	48.200	43.841	7.959
9	0.04945308	48.797	43.599	7.604
10	0.05067645	49.331	43.319	7.350
11	0.05181237	49.806	43.021	7.173
12	0.05287922	50.229	42.720	7.051
13	0.05388991	50.606	42.424	6.970
14	0.05485382	50.943	42.138	6.919
15	0.05577795	51.248	41.864	6.888
16	0.05666766	51.523	41.604	6.873
17	0.05752712	51.774	41.358	6.868
18	0.05835964	52.005	41.125	6.870
19	0.05916791	52.216	40.906	6.877
20	0.05995412	52.412	40.700	6.888
21	0.06072006	52.594	40.505	6.902
22	0.06146727	52.763	40.321	6.916
23	0.06219704	52.922	40.147	6.932
24	0.06291046	53.070	39.982	6.948

```
compute [vect[strings]] implabel=|| $
  "Australian Investment",$
  "Australian GDP",$
  "Australian Labor Productivity"||

@VARIRF(model=ausmodel,steps=nsteps,vlabels=implabel,byshocks,byvariables)
```

```
* Canada
* ______

* Use Clear Program!

calendar(a) 1950
open data

* Penn 7 G7 col a.xls

data(format=xls,org=columns) / popcan rgdpchcan kican rgdpwokcan

set rgdpcan = rgdpchcan*popcan
set investcan = kican*rgdpcan

set lnrgdpcan = log(rgdpcan)
set lninvestcan = log(investcan)
set lnlaborpwcan = log(rgdpwokcan)

graph(key=upleft) 1
# lnrgdpcan
graph(key=upleft) 1
# lninvestcan
graph(key=upleft) 1
# lnlaborpwcan

compute  neqn   = 3
compute  nlags  = 2
compute  nsteps = 12

grparm(nopatterns)
grparm(bold) header 36
grparm axislabeling 27
grparm keylabeling 27

system(model=canmodel)
variables lninvestcan lnrgdpcan lnlaborpwcan
lags 1 to nlags
det constant
end(system)

estimate(cvout=vcan)

VAR/System - Estimation by Least Squares
Dependent Variable LNINVESTCAN
Annual Data From 1952:01 To 2007:01
Usable Observations     56        Degrees of Freedom    49
Mean of Dependent Variable              22.952247596
Std Error of Dependent Variable         0.654620728
Standard Error of Estimate              0.078537908
Sum of Squared Residuals                0.3022419503
Durbin-Watson Statistic                 1.898783

  Variable                    Coeff          Std Error        T-Stat          Signif
********************************************************************************
```

1. LNINVESTCAN{1}	0.413290505	0.221814391	1.86323	0.06842953
2. LNINVESTCAN{2}	0.096808346	0.242124238	0.39983	0.69101996
3. LNRGDPCAN{1}	-0.402502283	1.603566593	-0.25100	0.80286032
4. LNRGDPCAN{2}	0.771754948	1.549091036	0.49820	0.62057294
5. LNLABORPWCAN{1}	2.222917026	1.357216772	1.63785	0.10785981
6. LNLABORPWCAN{2}	-1.721273508	1.202586382	-1.43131	0.15868900
7. Constant	-1.525164571	1.216972265	-1.25325	0.21606380

F-Tests, Dependent Variable LNINVESTCAN

Variable	F-Statistic	Signif
LNINVESTCAN	5.5913	0.0064977
LNRGDPCAN	2.2934	0.1116621
LNLABORPWCAN	1.5265	0.2274507

Dependent Variable LNRGDPCAN
Annual Data From 1952:01 To 2007:01
Usable Observations 56 Degrees of Freedom 49
Mean of Dependent Variable 20.062145596
Std Error of Dependent Variable 0.575079637
Standard Error of Estimate 0.018909522
Sum of Squared Residuals 0.0175209307
Durbin-Watson Statistic 1.914594

Variable	Coeff	Std Error	T-Stat	Signif
1. LNINVESTCAN{1}	-0.147751979	0.053406109	-2.76657	0.00796825
2. LNINVESTCAN{2}	0.033947762	0.058296097	0.58233	0.56301226
3. LNRGDPCAN{1}	1.098714079	0.386089698	2.84575	0.00645163
4. LNRGDPCAN{2}	-0.026435743	0.372973654	-0.07088	0.94378310
5. LNLABORPWCAN{1}	0.493764912	0.326776210	1.51102	0.13720639
6. LNLABORPWCAN{2}	-0.367027404	0.289545951	-1.26760	0.21093295
7. Constant	-0.174480111	0.293009630	-0.59548	0.55426605

F-Tests, Dependent Variable LNRGDPCAN

Variable	F-Statistic	Signif
LNINVESTCAN	6.5200	0.0030857
LNRGDPCAN	281.1832	0.0000000
LNLABORPWCAN	1.4389	0.2470414

Dependent Variable LNLABORPWCAN
Annual Data From 1952:01 To 2007:01
Usable Observations 56 Degrees of Freedom 49
Mean of Dependent Variable 10.783441991
Std Error of Dependent Variable 0.208749923
Standard Error of Estimate 0.019112144
Sum of Squared Residuals 0.0178984292
Durbin-Watson Statistic 1.985108

Variable	Coeff	Std Error	T-Stat	Signif
1. LNINVESTCAN{1}	-0.143018237	0.053978375	-2.64955	0.01081924
2. LNINVESTCAN{2}	0.052619880	0.058920762	0.89306	0.37618932
3. LNRGDPCAN{1}	-0.282350409	0.390226796	-0.72355	0.47277937
4. LNRGDPCAN{2}	0.368636660	0.376970207	0.97789	0.33293057
5. LNLABORPWCAN{1}	1.791709324	0.330277741	5.42486	0.00000178

6. LNLABORPWCAN{2}	-0.764964662	0.292648545	-2.61394	0.01185668
7. Constant	0.073358312	0.296149339	0.24771	0.80539607

F-Tests, Dependent Variable LNLABORPWCAN

Variable	F-Statistic	Signif
LNINVESTCAN	4.9697	0.0108356
LNRGDPCAN	2.7164	0.0760696
LNLABORPWCAN	69.2708	0.0000000

errors(model=canmodel,steps=24,cv=vcan)

Decomposition of Variance for Series LNINVESTCAN

Step	Std Error	LNINVESTCAN	LNRGDPCAN	LNLABORPWCAN
1	0.07346549	100.000	0.000	0.000
2	0.09352204	92.780	4.717	2.503
3	0.10432748	83.327	11.044	5.629
4	0.11143899	75.323	16.807	7.870
5	0.11664597	69.260	21.612	9.128
6	0.12074674	64.704	25.584	9.712
7	0.12416625	61.189	28.905	9.906
8	0.12714207	58.391	31.722	9.888
9	0.12980870	56.100	34.139	9.761
10	0.13224382	54.182	36.235	9.582
11	0.13449417	52.548	38.070	9.382
12	0.13658969	51.134	39.689	9.178
13	0.13855103	49.895	41.128	8.977
14	0.14039349	48.798	42.418	8.785
15	0.14212911	47.818	43.579	8.603
16	0.14376778	46.935	44.633	8.432
17	0.14531787	46.135	45.592	8.272
18	0.14678662	45.406	46.471	8.123
19	0.14818033	44.738	47.278	7.984
20	0.14950458	44.123	48.023	7.854
21	0.15076431	43.555	48.712	7.733
22	0.15196393	43.029	49.352	7.619
23	0.15310741	42.539	49.947	7.513
24	0.15419830	42.084	50.503	7.414

Decomposition of Variance for Series LNRGDPCAN

Step	Std Error	LNINVESTCAN	LNRGDPCAN	LNLABORPWCAN
1	0.01768824	59.104	40.896	0.000
2	0.02736228	38.426	60.132	1.443
3	0.03495162	25.460	71.714	2.826
4	0.04127100	18.302	78.209	3.489
5	0.04667610	14.443	81.918	3.638
6	0.05139485	12.323	84.139	3.538
7	0.05558784	11.126	85.531	3.343
8	0.05936664	10.436	86.435	3.128
9	0.06280842	10.036	87.040	2.923
10	0.06596777	9.807	87.455	2.738
11	0.06888482	9.614	87.954	2.432
13	0.07410907	9.586	88.107	2.307
14	0.07646096	9.580	88.222	2.198
15	0.07866296	9.588	88.310	2.102
16	0.08072942	9.603	88.379	2.017

17	0.08267269	9.622	88.435	1.943
18	0.08450348	9.643	88.481	1.876
19	0.08623118	9.664	88.519	1.817
20	0.08786403	9.685	88.552	1.763
21	0.08940933	9.705	88.580	1.715
22	0.09087357	9.724	88.604	1.672
23	0.09226256	9.742	88.626	1.632
24	0.09358152	9.758	88.645	1.597

Decomposition of Variance for Series LNLABORPWCAN

Step	Std Error	LNINVESTCAN	LNRGDPCAN	LNLABORPWCAN
1	0.01787777	46.992	39.148	13.861
2	0.02834809	25.899	50.892	23.210
3	0.03611678	16.566	55.713	27.720
4	0.04174412	12.401	58.080	29.519
5	0.04580431	10.411	59.589	30.000
6	0.04878135	9.380	60.749	29.871
7	0.05102209	8.809	61.721	29.469
8	0.05275754	8.477	62.563	28.960
9	0.05413857	8.280	63.298	28.422
10	0.05526453	8.162	63.945	27.893
11	0.05620237	8.094	64.516	27.390
12	0.05699831	8.057	65.022	26.921
13	0.05768506	8.040	65.473	26.487
14	0.05828629	8.036	65.877	26.087
15	0.05881940	8.040	66.241	25.719
16	0.05929743	8.050	66.569	25.381
17	0.05973029	8.062	66.868	25.069
18	0.06012557	8.077	67.141	24.782
19	0.06048921	8.093	67.392	24.515
20	0.06082587	8.109	67.623	24.268
21	0.06113925	8.125	67.836	24.038
22	0.06143234	8.142	68.034	23.824
23	0.06170756	8.157	68.219	23.623
24	0.06196689	8.173	68.392	23.435

```
compute [vect[strings]] implabel=|| $
  "Canadian Investment",$
  "Canadian GDP",$
  "Canadian Labor Productivity"||

@VARIRF(model=canmodel,steps=nsteps,vlabels=implabel,byshocks,byvariables)



* France
* _____

Use clear program!

calendar(a) 1950
open data

* Penn 7 G7 col a.xls
```

```
data(format=xls,org=columns) / popfra rgdpchfra kifra rgdpwokfra

set rgdpfra = rgdpchfra*popfra
set investfra = kifra*rgdpfra

set lnrgdpfra = log(rgdpfra)
set lninvestfra = log(investfra)
set lnlaborpwfra = log(rgdpwokfra)

graph(key=upleft) 1
# lnrgdpfra
graph(key=upleft) 1
# lninvestfra
graph(key=upleft) 1
# lnlaborpwfra

compute  neqn   = 3
compute  nlags  = 2
compute  nsteps = 12

grparm(nopatterns)
grparm(bold) header 36
grparm axislabeling 27
grparm keylabeling 27

system(model=framodel)
variables lninvestfra lnrgdpfra lnlaborpwfra
lags 1 to nlags
det constant
end(system)

estimate(cvout=vfra)
```

VAR/System - Estimation by Least Squares
Dependent Variable LNINVESTFRA
Annual Data From 1952:01 To 2007:01
Usable Observations 56 Degrees of Freedom 49
Mean of Dependent Variable 23.695671126
Std Error of Dependent Variable 0.575150889
Standard Error of Estimate 0.064610236
Sum of Squared Residuals 0.2045496502
Durbin-Watson Statistic 2.090131

Variable	Coeff	Std Error	T-Stat	Signif
1. LNINVESTFRA{1}	1.218901534	0.232533218	5.24184	0.00000336
2. LNINVESTFRA{2}	-0.281715336	0.203397139	-1.38505	0.17231075
3. LNRGDPFRA{1}	-2.337043806	2.966269487	-0.78787	0.43456587
4. LNRGDPFRA{2}	2.229119214	2.921781149	0.76293	0.44916169
5. LNLABORPWFRA{1}	1.979844235	3.121270140	0.63431	0.52883074
6. LNLABORPWFRA{2}	-1.796227014	3.086650961	-0.58193	0.56327913
7. Constant	1.821625017	2.712313445	0.67161	0.50498430

F-Tests, Dependent Variable LNINVESTFRA

Variable	F-Statistic	Signif

LNINVESTFRA	31.8653	0.0000000
LNRGDPFRA	0.3384	0.7145812
LNLABORPWFRA	0.2620	0.7705854

Dependent Variable LNRGDPFRA
Annual Data From 1952:01 To 2007:01
Usable Observations 56 Degrees of Freedom 49
Mean of Dependent Variable 20.706161945
Std Error of Dependent Variable 0.541855446
Standard Error of Estimate 0.015972665
Sum of Squared Residuals 0.0125011751
Durbin-Watson Statistic 2.040104

Variable	Coeff	Std Error	T-Stat	Signif
1. LNINVESTFRA{1}	0.082698666	0.057485862	1.43859	0.15662345
2. LNINVESTFRA{2}	-0.046519275	0.050282966	-0.92515	0.35942204
3. LNRGDPFRA{1}	0.292208159	0.733308389	0.39848	0.69200808
4. LNRGDPFRA{2}	0.620698493	0.722310174	0.85932	0.39434640
5. LNLABORPWFRA{1}	0.753305331	0.771626985	0.97626	0.33373301
6. LNLABORPWFRA{2}	-0.710392814	0.763068580	-0.93097	0.35643414
7. Constant	0.521820794	0.670526469	0.77823	0.44017790

F-Tests, Dependent Variable LNRGDPFRA

Variable	F-Statistic	Signif
LNINVESTFRA	1.2123	0.3062926
LNRGDPFRA	94.4268	0.0000000
LNLABORPWFRA	0.5138	0.6014294

Dependent Variable LNLABORPWFRA
Annual Data From 1952:01 To 2007:01
Usable Observations 56 Degrees of Freedom 49
Mean of Dependent Variable 10.640874284
Std Error of Dependent Variable 0.433429965
Standard Error of Estimate 0.014369135
Sum of Squared Residuals 0.0101171306
Durbin-Watson Statistic 2.084967

Variable	Coeff	Std Error	T-Stat	Signif
1. LNINVESTFRA{1}	0.084715631	0.051714736	1.63813	0.10780042
2. LNINVESTFRA{2}	-0.050497005	0.045234953	-1.11633	0.26972659
3. LNRGDPFRA{1}	-0.847273789	0.659690018	-1.28435	0.20505831
4. LNRGDPFRA{2}	0.785522785	0.649795936	1.20888	0.23251159
5. LNLABORPWFRA{1}	1.842674953	0.694161728	2.65453	0.01068082
6. LNLABORPWFRA{2}	-0.832875432	0.686462520	-1.21329	0.23083689
7. Constant	0.391510980	0.603210906	0.64904	0.51934004

F-Tests, Dependent Variable LNLABORPWFRA

Variable	F-Statistic	Signif
LNINVESTFRA	1.4966	0.2339397
LNRGDPFRA	1.1186	0.3349493
LNLABORPWFRA	59.6251	0.0000000

errors(model=framodel,steps=24,cv=vfra)

Decomposition of Variance for Series LNINVESTFRA

Step	Std Error	LNINVESTFRA	LNRGDPFRA	LNLABORPWFRA
1	0.06043734	100.000	0.000	0.000
2	0.08993809	99.367	0.284	0.349
3	0.10935180	98.865	0.521	0.614
4	0.12303458	98.591	0.621	0.788
5	0.13322895	98.439	0.640	0.921
6	0.14114152	98.339	0.624	1.037
7	0.14746832	98.260	0.597	1.143
8	0.15264303	98.188	0.567	1.245
9	0.15695342	98.118	0.539	1.342
10	0.16059927	98.047	0.516	1.437
11	0.16372381	97.975	0.496	1.529
12	0.16643224	97.901	0.481	1.618
13	0.16880337	97.826	0.469	1.705
14	0.17089722	97.750	0.460	1.789
15	0.17276020	97.674	0.454	1.871
16	0.17442864	97.599	0.450	1.951
17	0.17593135	97.524	0.448	2.028
18	0.17729143	97.449	0.447	2.103
19	0.17852759	97.377	0.447	2.176
20	0.17965518	97.306	0.448	2.247
21	0.18068688	97.236	0.449	2.315
22	0.18163327	97.168	0.450	2.381
23	0.18250329	97.103	0.452	2.445
24	0.18330455	97.039	0.454	2.507

Decomposition of Variance for Series LNRGDPFRA

Step	Std Error	LNINVESTFRA	LNRGDPFRA	LNLABORPWFRA
1	0.01494106	65.878	34.122	0.000
2	0.02390196	73.345	25.940	0.715
3	0.03108718	77.933	20.805	1.262
4	0.03724223	80.951	17.471	1.578
5	0.04272898	83.077	15.152	1.771
6	0.04772672	84.659	13.435	1.906
7	0.05233128	85.881	12.107	2.012
8	0.05660043	86.850	11.047	2.103
9	0.06057347	87.632	10.182	2.186
10	0.06427977	88.271	9.466	2.263
11	0.06774283	88.799	8.863	2.337
12	0.07098228	89.239	8.352	2.410
13	0.07401510	89.606	7.913	2.481
14	0.07685629	89.915	7.533	2.551
15	0.07951929	90.176	7.203	2.621
16	0.08201629	90.396	6.913	2.690
17	0.08435839	90.583	6.658	2.760
18	0.08655581	90.740	6.431	2.829
19	0.08861794	90.873	6.229	2.897
20	0.09055345	90.985	6.049	2.966
21	0.09237037	91.079	5.887	3.034
22	0.09407612	91.157	5.741	3.102
23	0.09567763	91.222	5.609	3.169
24	0.09718131	91.275	5.489	3.235

Decomposition of Variance for Series LNLABORPWFRA

Step	Std Error	LNINVESTFRA	LNRGDPFRA	LNLABORPWFRA
1	0.01344110	61.641	34.373	3.986
2	0.02145033	68.588	24.533	6.878
3	0.02776088	72.751	19.053	8.196
4	0.03306631	75.517	15.733	8.750
5	0.03771819	77.501	13.518	8.981
6	0.04189403	79.001	11.920	9.079
7	0.04568986	80.174	10.705	9.121
8	0.04916435	81.112	9.747	9.141
9	0.05235786	81.872	8.974	9.154
10	0.05530081	82.496	8.337	9.166
11	0.05801757	83.011	7.806	9.183
12	0.06052853	83.438	7.357	9.205
13	0.06285120	83.794	6.974	9.232
14	0.06500100	84.090	6.644	9.266
15	0.06699162	84.337	6.358	9.305
16	0.06883542	84.714	5.890	9.397
18	0.07212626	84.855	5.697	9.449
19	0.07359282	84.970	5.525	9.504
20	0.07495178	85.064	5.373	9.563
21	0.07621100	85.139	5.237	9.624
22	0.07737770	85.198	5.115	9.687
23	0.07845856	85.243	5.006	9.752
24	0.07945972	85.275	4.907	9.818

```
compute [vect[strings]] implabel=|| $
  "French Investment",$
  "French GDP",$
  "French Labor Productivity"||

@VARIRF(model=framodel,steps=nsteps,vlabels=implabel,byshocks,byvariables)



* Germany
* _______

Use clear program!

calendar(a) 1970
open data

* Penn 7 G7 col a.xls

data(format=xls,org=columns) / popger rgdpchger kiger rgdpwokger

set rgdpger = rgdpchger*popger
set investger = kiger*rgdpger

set lnrgdpger = log(rgdpger)
set lninvestger = log(investger)
set lnlaborpwger = log(rgdpwokger)

graph(key=upleft) 1
```

```
# lnrgdpger
graph(key=upleft) 1
# lninvestger
graph(key=upleft) 1
# lnlaborpwger

compute  neqn   = 3
compute  nlags  = 2
compute  nsteps = 12

grparm(nopatterns)
grparm(bold) header 36
grparm axislabeling 27
grparm keylabeling 27

system(model=germodel)
variables lninvestger lnrgdpger lnlaborpwger
lags 1 to nlags
det constant
end(system)

estimate(cvout=vger)
```

VAR/System - Estimation by Least Squares
Dependent Variable LNINVESTGER
Annual Data From 1992:01 To 2027:01
Usable Observations 36 Degrees of Freedom 29
Mean of Dependent Variable 24.460201609
Std Error of Dependent Variable 0.195695707
Standard Error of Estimate 0.048756696
Sum of Squared Residuals 0.0689392476
Durbin-Watson Statistic 1.843243

Variable	Coeff	Std Error	T-Stat	Signif
1. LNINVESTGER{1}	1.014737221	0.368861309	2.75100	0.01013071
2. LNINVESTGER{2}	-0.416421105	0.276178036	-1.50780	0.14242363
3. LNRGDPGER{1}	1.333110234	1.380646048	0.96557	0.34224308
4. LNRGDPGER{2}	0.512939416	1.340144896	0.38275	0.70469680
5. LNLABORPWGER{1}	-1.855753327	1.094409757	-1.69567	0.10066126
6. LNLABORPWGER{2}	-0.277847497	1.298141434	-0.21403	0.83201769
7. Constant	-6.482131566	3.310582438	-1.95800	0.05991263

F-Tests, Dependent Variable LNINVESTGER

Variable	F-Statistic	Signif
LNINVESTGER	7.1944	0.0029027
LNRGDPGER	4.3114	0.0229469
LNLABORPWGER	4.9918	0.0137083

Dependent Variable LNRGDPGER
Annual Data From 1992:01 To 2027:01
Usable Observations 36 Degrees of Freedom 29
Mean of Dependent Variable 21.411669015
Std Error of Dependent Variable 0.220549270
Standard Error of Estimate 0.014289011

Sum of Squared Residuals 0.0059210993
Durbin-Watson Statistic 1.880821

Variable	Coeff	Std Error	T-Stat	Signif
1. LNINVESTGER{1}	0.072931710	0.108101322	0.67466	0.50523478
2. LNINVESTGER{2}	-0.115632942	0.080938852	-1.42865	0.16378914
3. LNRGDPGER{1}	1.457161006	0.404622712	3.60128	0.00116687
4. LNRGDPGER{2}	-0.140374166	0.392753134	-0.35741	0.72337241
5. LNLABORPWGER{1}	-0.480055088	0.320736111	-1.49673	0.14526917
6. LNLABORPWGER{2}	0.063405606	0.380443277	0.16666	0.86879229
7. Constant	-1.189958632	0.970224661	-1.22648	0.22988455

F-Tests, Dependent Variable LNRGDPGER

Variable	F-Statistic	Signif
LNINVESTGER	2.3537	0.1129201
LNRGDPGER	26.7648	0.0000003
LNLABORPWGER	2.6571	0.0871761

Dependent Variable LNLABORPWGER
Annual Data From 1992:01 To 2027:01
Usable Observations 36 Degrees of Freedom 29
Mean of Dependent Variable 10.875261318
Std Error of Dependent Variable 0.158643236
Standard Error of Estimate 0.015129044
Sum of Squared Residuals 0.0066377511
Durbin-Watson Statistic 1.885574

Variable	Coeff	Std Error	T-Stat	Signif
1. LNINVESTGER{1}	0.033969296	0.114456462	0.29679	0.76874377
2. LNINVESTGER{2}	-0.068509701	0.085697144	-0.79944	0.43053519
3. LNRGDPGER{1}	0.201221669	0.428409968	0.46969	0.64208623
4. LNRGDPGER{2}	0.253521643	0.415842593	0.60966	0.54683609
5. LNLABORPWGER{1}	0.798001248	0.339591780	2.34988	0.02579709
6. LNLABORPWGER{2}	-0.411373115	0.402809055	-1.02126	0.31557532
7. Constant	-2.208154559	1.027262939	-2.14955	0.04006657

F-Tests, Dependent Variable LNLABORPWGER

Variable	F-Statistic	Signif
LNINVESTGER	0.9465	0.3997540
LNRGDPGER	2.7367	0.0815162
LNLABORPWGER	3.8427	0.0330851

errors(model=germodel,steps=24,cv=vger)

Decomposition of Variance for Series LNINVESTGER

Step	Std Error	LNINVESTGER	LNRGDPGER	LNLABORPWGER
1	0.04376047	100.000	0.000	0.000
2	0.06013178	95.746	0.016	4.238
3	0.06968944	80.029	0.018	19.953
4	0.07971465	61.866	0.123	38.011
5	0.08834384	50.379	0.358	49.263
6	0.09372794	44.758	0.697	54.545
7	0.09634054	42.371	1.125	56.505

8	0.09741755	41.477	1.611	56.912
9	0.09789402	41.154	2.116	56.391
11	0.09852972	40.913	3.051	56.036
12	0.09883779	40.856	3.452	55.691
13	0.09913352	40.830	3.810	55.360
14	0.09941646	40.819	4.131	55.051
15	0.09969385	40.804	4.422	54.775
16	0.09997194	40.773	4.689	54.538
17	0.10025161	40.725	4.938	54.337
18	0.10052919	40.663	5.173	54.164
19	0.10079947	40.594	5.396	54.011
20	0.10105818	40.523	5.609	53.868
21	0.10130308	40.456	5.813	53.731
22	0.10153374	40.394	6.009	53.597
23	0.10175096	40.337	6.197	53.466
24	0.10195606	40.286	6.376	53.338

Decomposition of Variance for Series LNRGDPGER

Step	Std Error	LNINVESTGER	LNRGDPGER	LNLABORPWGER
1	0.01282478	74.770	25.230	0.000
2	0.02062326	76.418	21.171	2.411
3	0.02591010	69.010	20.628	10.362
4	0.03033041	57.965	20.599	21.436
5	0.03427913	48.600	20.786	30.614
6	0.03752617	42.480	21.452	36.068
7	0.04000951	38.916	22.593	38.491
8	0.04188672	36.926	24.029	39.044
9	0.04336453	35.816	25.563	38.622
10	0.04460213	35.178	27.048	37.774
11	0.04569675	34.798	28.403	36.798
12	0.04670117	34.561	29.597	35.842
13	0.04764297	34.398	30.628	34.974
14	0.04853680	34.269	31.510	34.222
15	0.04939039	34.147	32.263	33.590
16	0.05020732	34.022	32.909	33.070
17	0.05098856	33.889	33.468	32.642
18	0.05173374	33.752	33.961	32.287
19	0.05244228	33.615	34.400	31.985
20	0.05311403	33.482	34.799	31.719
21	0.05374964	33.358	35.164	31.478
22	0.05435048	33.244	35.500	31.256
23	0.05491844	33.139	35.813	31.048
24	0.05545568	33.045	36.102	30.852

Decomposition of Variance for Series LNLABORPWGER

Step	Std Error	LNINVESTGER	LNRGDPGER	LNLABORPWGER
1	0.01357873	62.094	13.773	24.132
2	0.01977926	67.664	13.720	18.616
3	0.02250311	69.682	15.897	14.420
4	0.02435643	66.440	18.100	15.460
5	0.02636510	59.940	19.426	20.634
6	0.02837733	53.800	20.305	25.896
7	0.03011886	49.389	21.227	29.384
8	0.03151909	46.512	22.334	31.154
9	0.03263517	44.657	23.575	31.768

10	0.03355295	43.426	24.854	31.721
11	0.03434267	42.573	26.086	31.341
12	0.03505048	41.953	27.220	30.826
13	0.03570343	41.478	28.236	30.287
14	0.03631664	41.090	29.130	29.780
15	0.03689853	40.753	29.911	29.336
16	0.03745377	40.445	30.592	28.963
17	0.03798468	40.153	31.190	28.657
18	0.03849214	39.873	31.718	28.409
19	0.03897625	39.604	32.189	28.035
21	0.03987440	39.111	33.004	27.885
22	0.04028908	38.889	33.361	27.750
23	0.04068186	38.684	33.692	27.624
24	0.04105388	38.496	33.999	27.505

```
compute [vect[strings]] implabel=|| $
  "German Investment",$
  "German GDP",$
  "German Labor Productivity"||

@VARIRF(model=germodel,steps=nsteps,vlabels=implabel,byshocks,byvariables)



* Italy
* _____

Use Clear Program!

calendar(a) 1950
open data

* Penn 7 G7 col a.xls

data(format=xls,org=columns) / popita rgdpchita kiita rgdpwokita

set rgdpita = rgdpchita*popita
set investita = kiita*rgdpita

set lnrgdpita = log(rgdpita)
set lninvestita = log(investita)
set lnlaborpwita = log(rgdpwokita)

graph(key=upleft) 1
# lnrgdpita
graph(key=upleft) 1
# lninvestita
graph(key=upleft) 1
# lnlaborpwita

compute  neqn   = 3
compute  nlags  = 2
compute  nsteps = 12

grparm(nopatterns)
```

```
grparm(bold) header 36
grparm axislabeling 27
grparm keylabeling 27

system(model=itamodel)
variables lninvestita lnrgdpita lnlaborpwita
lags 1 to nlags
det constant
end(system)

estimate(cvout=vita)
```

VAR/System - Estimation by Least Squares
Dependent Variable LNINVESTITA
Annual Data From 1952:01 To 2007:01

Usable Observations	56	Degrees of Freedom	49
Mean of Dependent Variable		23.804682098	
Std Error of Dependent Variable		0.525349156	
Standard Error of Estimate		0.071797602	
Sum of Squared Residuals		0.2525898890	
Durbin-Watson Statistic		1.960000	

Variable	Coeff	Std Error	T-Stat	Signif
1. LNINVESTITA{1}	0.619981953	0.302981986	2.04627	0.04611537
2. LNINVESTITA{2}	0.155383960	0.290548191	0.53480	0.59520968
3. LNRGDPITA{1}	0.792559242	1.692470338	0.46829	0.64165694
4. LNRGDPITA{2}	-0.482671031	1.565872866	-0.30824	0.75920323
5. LNLABORPWITA{1}	-0.086391311	1.056867199	-0.08174	0.93518421
6. LNLABORPWITA{2}	-0.044773432	1.021630812	-0.04383	0.96522165
7. Constant	0.364601900	2.860328546	0.12747	0.89909126

F-Tests, Dependent Variable LNINVESTITA

Variable	F-Statistic	Signif
LNINVESTITA	24.2798	0.0000000
LNRGDPITA	0.6195	0.5423637
LNLABORPWITA	0.1202	0.8869958

Dependent Variable LNRGDPITA
Annual Data From 1952:01 To 2007:01

Usable Observations	56	Degrees of Freedom	49
Mean of Dependent Variable		20.636568842	
Std Error of Dependent Variable		0.554543599	
Standard Error of Estimate		0.017931210	
Sum of Squared Residuals		0.0157548870	
Durbin-Watson Statistic		1.922308	

Variable	Coeff	Std Error	T-Stat	Signif
1. LNINVESTITA{1}	-0.140400194	0.075668735	-1.85546	0.06955113
2. LNINVESTITA{2}	0.119260196	0.072563436	1.64353	0.10667552
3. LNRGDPITA{1}	1.393483939	0.422688791	3.29671	0.00182466
4. LNRGDPITA{2}	-0.427866507	0.391071497	-1.09409	0.27926583
5. LNLABORPWITA{1}	0.078973748	0.263949039	0.29920	0.76605229
6. LNLABORPWITA{2}	-0.041608214	0.255148869	-0.16307	0.87113067

7. Constant	0.838182260	0.714357463	1.17334	0.24633264

F-Tests, Dependent Variable LNRGDPITA

Variable	F-Statistic	Signif
LNINVESTITA	1.7471	0.1849580
LNRGDPITA	105.4098	0.0000000
LNLABORPWITA	0.1682	0.8456561

Dependent Variable LNLABORPWITA
Annual Data From 1952:01 To 2007:01
Usable Observations 56 Degrees of Freedom 49
Mean of Dependent Variable 10.593339872
Std Error of Dependent Variable 0.532236998
Standard Error of Estimate 0.018422737
Sum of Squared Residuals 0.0166304647
Durbin-Watson Statistic 2.047926

Variable	Coeff	Std Error	T-Stat	Signif
**********	**********	**********	**********	**********
1. LNINVESTITA{1}	-0.165700018	0.077742950	-2.13138	0.03809868
2. LNINVESTITA{2}	0.176709637	0.074552530	2.37027	0.02175497
3. LNRGDPITA{1}	0.261235020	0.434275448	0.60154	0.55025201
4. LNRGDPITA{2}	-0.255197762	0.401791468	-0.63515	0.52828572
5. LNLABORPWITA{1}	1.306402769	0.271184355	4.81740	0.00001443
6. LNLABORPWITA{2}	-0.345266712	0.262142957	-1.31709	0.19393373
7. Constant	0.043160673	0.733939280	0.05881	0.95334511

F-Tests, Dependent Variable LNLABORPWITA

Variable	F-Statistic	Signif
LNINVESTITA	2.8297	0.0687107
LNRGDPITA	0.2163	0.8062714
LNLABORPWITA	98.0495	0.0000000

errors(model=itamodel,steps=24,cv=vita)

Decomposition of Variance for Series LNINVESTITA

Step	Std Error	LNINVESTITA	LNRGDPITA	LNLABORPWITA
1	0.06716051	100.000	0.000	0.000
2	0.08537212	99.623	0.370	0.007
3	0.09640475	99.177	0.802	0.021
4	0.10376853	98.736	1.227	0.037
5	0.10893871	98.308	1.642	0.050
6	0.11269723	97.887	2.054	0.060
7	0.11551358	97.470	2.466	0.064
8	0.11768796	97.056	2.881	0.064
9	0.11941905	96.642	3.296	0.062
10	0.12084094	96.230	3.709	0.061
11	0.12204530	95.819	4.118	0.064
12	0.12309525	95.411	4.518	0.071
13	0.12403450	95.007	4.906	0.087
14	0.12489338	94.610	5.281	0.110
15	0.12569291	94.220	5.638	0.142
16	0.12644760	93.840	6.298	0.230
18	0.12785873	93.119	6.597	0.285
19	0.12852603	92.780	6.875	0.345

20	0.12917181	92.457	7.133	0.410
21	0.12979745	92.152	7.371	0.477
22	0.13040353	91.864	7.589	0.547
23	0.13099006	91.595	7.789	0.616
24	0.13155674	91.344	7.971	0.686

Decomposition of Variance for Series LNRGDPITA

Step	Std Error	LNINVESTITA	LNRGDPITA	LNLABORPWITA
1	0.01677311	80.074	19.926	0.000
2	0.02368397	67.938	31.990	0.072
3	0.02919648	61.112	38.584	0.304
4	0.03390435	57.056	42.248	0.696
5	0.03809535	54.548	44.241	1.211
6	0.04193037	52.985	45.211	1.803
7	0.04550318	52.047	45.522	2.431
8	0.04886910	51.545	45.395	3.060
9	0.05206079	51.357	44.977	3.667
10	0.05509730	51.397	44.369	4.233
11	0.05798951	51.605	43.645	4.751
12	0.06074351	51.931	42.854	5.624
14	0.06584895	52.803	41.216	5.980
15	0.06820396	53.298	40.414	6.288
16	0.07042926	53.809	39.641	6.550
17	0.07252681	54.321	38.906	6.773
18	0.07449910	54.826	38.215	6.960
19	0.07634919	55.316	37.568	7.116
20	0.07808074	55.786	36.968	7.246
21	0.07969789	56.234	36.414	7.353
22	0.08120524	56.656	35.904	7.440
23	0.08260775	57.052	35.436	7.512
24	0.08391059	57.422	35.008	7.570

Decomposition of Variance for Series LNLABORPWITA

Step	Std Error	LNINVESTITA	LNRGDPITA	LNLABORPWITA
1	0.01723289	53.604	24.557	21.839
2	0.02579972	36.841	36.786	26.373
3	0.03323293	31.940	40.716	27.345
4	0.03983139	33.146	40.327	26.526
6	0.05129330	35.452	38.855	25.693
7	0.05634633	37.977	37.228	24.795
8	0.06100614	40.463	35.637	23.900
9	0.06529653	42.794	34.163	23.043
10	0.06923646	44.921	32.838	22.241
11	0.07284381	46.831	31.666	21.503
12	0.07613689	48.530	30.639	20.830
13	0.07913477	50.033	29.746	20.221
14	0.08185720	51.356	28.973	19.671
15	0.08432427	52.518	28.304	19.178
16	0.08655606	53.536	27.728	18.736
17	0.08857227	54.428	27.232	18.340
18	0.09039191	55.208	26.805	17.986
19	0.09203310	55.890	26.439	17.671
20	0.09351293	56.487	26.125	17.389
21	0.09484728	57.008	25.855	17.138
22	0.09605084	57.464	25.623	16.913

```
   23   0.09713706      57.862          25.425          16.713
   24   0.09811819      58.212          25.255          16.534

compute [vect[strings]] implabel=|| $
  "Italian Investment",$
  "Italian GDP",$
  "Italian Labor Productivity"||

@VARIRF(model=itamodel,steps=nsteps,vlabels=implabel,byshocks,byvariables)



* Japan
* _____

Use Clear program!

calendar(a) 1950
open data

* Penn 7 G7 col a.xls

data(format=xls,org=columns) / popjpn rgdpchjpn kijpn rgdpwokjpn

set rgdpjpn = rgdpchjpn*popjpn
set investjpn = kijpn*rgdpjpn

set lnrgdpjpn = log(rgdpjpn)
set lninvestjpn = log(investjpn)
set lnlaborpwjpn = log(rgdpwokjpn)

graph(key=upleft) 1
# lnrgdpjpn

graph(key=upleft) 1
# lninvestjpn
graph(key=upleft) 1
# lnlaborpwjpn
compute  neqn   = 3
compute  nlags  = 2
compute  nsteps = 12

grparm(nopatterns)
grparm(bold) header 36
grparm axislabeling 27
grparm keylabeling 27

system(model=jpnmodel)
variables lninvestjpn lnrgdpjpn lnlaborpwjpn
lags 1 to nlags
det constant
end(system)

estimate(cvout=vjpn)
```

VAR/System - Estimation by Least Squares
Dependent Variable LNINVESTJPN
Annual Data From 1952:01 To 2007:01
Usable Observations 56 Degrees of Freedom 49
Mean of Dependent Variable 24.580134688
Std Error of Dependent Variable 1.001811580
Standard Error of Estimate 0.076950480
Sum of Squared Residuals 0.2901474458
Durbin-Watson Statistic 1.326403

Variable	Coeff	Std Error	T-Stat	Signif
1. LNINVESTJPN{1}	0.819746122	0.177118261	4.62824	0.00002732
2. LNINVESTJPN{2}	0.140357430	0.163536112	0.85827	0.39492471
3. LNRGDPJPN{1}	-0.654223903	1.665627335	-0.39278	0.69618607
4. LNRGDPJPN{2}	0.793977649	1.594393433	0.49798	0.62072516
5. LNLABORPWJPN{1}	2.116745114	1.641821230	1.28927	0.20335845
6. LNLABORPWJPN{2}	-2.257414894	1.571921598	-1.43609	0.15733169
7. Constant	-0.525269507	2.933948968	-0.17903	0.85865114

F-Tests, Dependent Variable LNINVESTJPN

Variable	F-Statistic	Signif
LNINVESTJPN	40.7268	0.0000000
LNRGDPJPN	0.2774	0.7589267
LNLABORPWJPN	1.0902	0.3441697

Dependent Variable LNRGDPJPN
Annual Data From 1952:01 To 2007:01
Usable Observations 56 Degrees of Freedom 49
Mean of Dependent Variable 21.260944834
Std Error of Dependent Variable 0.815980171
Standard Error of Estimate 0.022551638
Sum of Squared Residuals 0.0249202435
Durbin-Watson Statistic 1.802708

Variable	Coeff	Std Error	T-Stat	Signif
1. LNINVESTJPN{1}	0.062750290	0.051907499	1.20889	0.23250752
2. LNINVESTJPN{2}	-0.029411743	0.047927021	-0.61368	0.54226690
3. LNRGDPJPN{1}	0.291099127	0.488140233	0.59634	0.55369111
4. LNRGDPJPN{2}	0.652522740	0.467263935	1.39648	0.16886530
5. LNLABORPWJPN{1}	1.066894484	0.481163452	2.21732	0.03127084
6. LNLABORPWJPN{2}	-1.075265988	0.460678184	-2.33409	0.02373518
7. Constant	0.500628868	0.859843318	0.58223	0.56307953

F-Tests, Dependent Variable LNRGDPJPN

Variable	F-Statistic	Signif
LNINVESTJPN	0.9160	0.4068475
LNRGDPJPN	63.7544	0.0000000
LNLABORPWJPN	2.7299	0.0751521

Dependent Variable LNLABORPWJPN
Annual Data From 1952:01 To 2007:01
Usable Observations 56 Degrees of Freedom 49
Mean of Dependent Variable 10.337415266

Std Error of Dependent Variable	0.655775166
Standard Error of Estimate	0.021373702
Sum of Squared Residuals	0.0223849223
Durbin-Watson Statistic	1.862298

Variable	Coeff	Std Error	T-Stat	Signif
1. LNINVESTJPN{1}	0.071514106	0.049196223	1.45365	0.15241851
2. LNINVESTJPN{2}	-0.025212282	0.045423656	-0.55505	0.58138736
3. LNRGDPJPN{1}	-0.990358774	0.462643281	-2.14065	0.03730404
4. LNRGDPJPN{2}	0.985192161	0.442857411	2.22463	0.03074377
5. LNLABORPWJPN{1}	2.270416175	0.456030917	4.97865	0.00000832
6. LNLABORPWJPN{2}	-1.359586640	0.436615653	-3.11392	0.00308082
7. Constant	-0.075603718	0.814931256	-0.09277	0.92646209

F-Tests, Dependent Variable LNLABORPWJPN

Variable	F-Statistic	Signif
LNINVESTJPN	1.5983	0.2126009
LNRGDPJPN	2.5137	0.0913580
LNLABORPWJPN	31.5767	0.0000000

errors(model=jpnmodel,steps=24,cv=vjpn)

Decomposition of Variance for Series LNINVESTJPN

Step	Std Error	LNINVESTJPN	LNRGDPJPN	LNLABORPWJPN
1	0.07198058	100.000	0.000	0.000
2	0.10858194	95.809	2.951	1.241
3	0.14033581	93.605	3.521	2.874
4	0.16680919	92.641	3.536	3.822
5	0.18971512	92.588	3.323	4.088
6	0.21007019	92.976	3.072	3.952
7	0.22852797	93.522	2.835	3.643
8	0.24542433	94.082	2.626	3.292
9	0.26093521	94.595	2.446	2.959
10	0.27516425	95.037	2.292	2.671
11	0.28818830	95.405	2.160	2.435
12	0.30007512	95.702	2.047	2.252
13	0.31088945	95.934	1.950	2.116
14	0.32069482	96.108	1.867	2.025
15	0.32955396	96.231	1.797	1.972
16	0.33752900	96.311	1.737	1.953
17	0.34468134	96.353	1.685	1.961
18	0.35107149	96.365	1.642	1.993
19	0.35675879	96.351	1.606	2.044
20	0.36180107	96.316	1.575	2.109
21	0.36625426	96.264	1.549	2.187
22	0.37017210	96.199	1.528	2.273
23	0.37360583	96.125	1.511	2.364
24	0.37660397	96.043	1.498	2.459

Decomposition of Variance for Series LNRGDPJPN

Step	Std Error	LNINVESTJPN	LNRGDPJPN	LNLABORPWJPN
1	0.02109513	55.186	44.814	0.000
2	0.03720690	59.066	38.250	2.684
3	0.05094847	60.951	33.586	5.463

4	0.06280460	63.353	29.667	6.979
5	0.07337134	66.183	26.415	7.401
6	0.08312073	69.137	23.685	7.178
7	0.09232424	71.969	21.377	6.654
8	0.10110520	74.551	19.417	6.033
9	0.10950539	76.838	17.748	5.414
10	0.11753134	78.834	16.323	4.843
11	0.12517806	80.559	15.104	4.337
12	0.13243889	82.042	14.057	3.901
13	0.13930892	83.313	13.156	3.531
14	0.14578598	84.397	12.378	3.225
15	0.15187077	85.321	11.705	2.974
16	0.15756687	86.104	11.121	2.775
17	0.16288057	86.766	10.614	2.619
18	0.16782063	87.324	10.173	2.503
19	0.17239798	87.791	9.789	2.420
20	0.17662547	88.180	9.454	2.366
21	0.18051745	88.502	9.161	2.337
22	0.18408952	88.766	8.906	2.328
23	0.18735820	88.979	8.684	2.337
24	0.19034058	89.150	8.489	2.360

Decomposition of Variance for Series LNLABORPWJPN

Step	Std Error	LNINVESTJPN	LNRGDPJPN	LNLABORPWJPN
1	0.01999327	48.401	43.432	8.167
2	0.03565881	50.589	33.610	15.802
3	0.04897058	52.405	27.847	19.748
4	0.06036176	55.480	23.695	20.825
5	0.07046987	59.267	20.550	20.183
6	0.07979554	63.235	18.055	18.709
7	0.08861344	67.024	16.025	16.950
8	0.09703829	70.455	14.349	15.196
9	0.10510107	73.469	12.953	13.577
10	0.11279906	76.074	11.784	12.142
11	0.12012014	78.304	10.800	10.896
12	0.12705244	80.202	9.968	9.831
13	0.13358738	81.810	9.262	8.928
14	0.13972044	83.169	8.660	8.171
15	0.14545116	84.314	8.146	7.540
16	0.15078292	85.275	7.706	6.592
18	0.16028010	86.750	7.003	6.248
19	0.16446811	87.305	6.723	5.973
20	0.16830144	87.762	6.481	5.757
21	0.17179665	88.135	6.272	5.592
22	0.17497162	88.437	6.093	5.470
23	0.17784515	88.679	5.938	5.383
24	0.18043659	88.869	5.804	5.327

```
compute [vect[strings]] implabel=|| $
  "Japanese Investment",$
  "Japanese GDP",$
  "Japanese Labor Productivity"||

@VARIRF(model=jpnmodel,steps=nsteps,vlabels=implabel,byshocks,byvariables)
```

```
* United Kingdom
* _____

Use Clear Program!

calendar(a) 1950
open data

* Penn 7 G7 col b.xls

data(format=xls,org=columns) / popgbr rgdpchgbr kigbr rgdpwokgbr

set rgdpgbr = rgdpchgbr*popgbr
set investgbr = kigbr*rgdpgbr

set lnrgdpgbr = log(rgdpgbr)
set lninvestgbr = log(investgbr)
set lnlaborpwgbr = log(rgdpwokgbr)

graph(key=upleft) 1
# lnrgdpgbr
graph(key=upleft) 1
# lninvestgbr
graph(key=upleft) 1
# lnlaborpwgbr

compute  neqn   = 3
compute  nlags  = 2
compute  nsteps = 12

grparm(nopatterns)
grparm(bold) header 36
grparm axislabeling 27
grparm keylabeling 27

system(model=gbrmodel)
variables lninvestgbr lnrgdpgbr lnlaborpwgbr
lags 1 to nlags
det constant
end(system)

estimate(cvout=vgbr)

VAR/System - Estimation by Least Squares
Dependent Variable LNINVESTGBR
Annual Data From 1952:01 To 2007:01
Usable Observations     56        Degrees of Freedom    49
Mean of Dependent Variable              23.471763739
Std Error of Dependent Variable         0.518414615
Standard Error of Estimate              0.074396728
Sum of Squared Residuals                0.2712087822
Durbin-Watson Statistic                 1.505093

  Variable                    Coeff          Std Error        T-Stat          Signif
********************************************************************************
```

1. LNINVESTGBR{1}	0.291608936	0.209943419	1.38899	0.17111723
2. LNINVESTGBR{2}	0.471022962	0.187634608	2.51032	0.01541312
3. LNRGDPGBR{1}	1.561155299	1.717216908	0.90912	0.36773718
4. LNRGDPGBR{2}	-1.367234036	1.649271170	-0.82899	0.41112859
5. LNLABORPWGBR{1}	1.936366479	1.626939204	1.19019	0.23970636
6. LNLABORPWGBR{2}	-1.819204344	1.630700804	-1.11560	0.27003620
7. Constant	0.273646444	4.897296740	0.05588	0.95566699

F-Tests, Dependent Variable LNINVESTGBR

Variable	F-Statistic	Signif
LNINVESTGBR	30.5318	0.0000000
LNRGDPGBR	0.4150	0.6626092
LNLABORPWGBR	0.7152	0.4941243

Dependent Variable LNRGDPGBR
Annual Data From 1952:01 To 2007:01
Usable Observations 56 Degrees of Freedom 49
Mean of Dependent Variable 20.802378239
Std Error of Dependent Variable 0.392521902
Standard Error of Estimate 0.015783626
Sum of Squared Residuals 0.0122070198
Durbin-Watson Statistic 1.818607

Variable	Coeff	Std Error	T-Stat	Signif
1. LNINVESTGBR{1}	-0.115340423	0.044540513	-2.58956	0.01261835
2. LNINVESTGBR{2}	0.090991802	0.039807591	2.28579	0.02662989
3. LNRGDPGBR{1}	1.324612102	0.364315884	3.63589	0.00066405
4. LNRGDPGBR{2}	-0.363015500	0.349900867	-1.03748	0.30460456
5. LNLABORPWGBR{1}	0.415011836	0.345163032	1.20236	0.23500054
6. LNLABORPWGBR{2}	-0.331383724	0.345961074	-0.95786	0.34283372
7. Constant	0.495265653	1.038985223	0.47668	0.63570750

F-Tests, Dependent Variable LNRGDPGBR

Variable	F-Statistic	Signif
LNINVESTGBR	3.3538	0.0431419
LNRGDPGBR	28.8753	0.0000000
LNLABORPWGBR	0.7557	0.4750642

Dependent Variable LNLABORPWGBR
Annual Data From 1952:01 To 2007:01
Usable Observations 56 Degrees of Freedom 49
Mean of Dependent Variable 10.611052071
Std Error of Dependent Variable 0.323833145
Standard Error of Estimate 0.015040678
Sum of Squared Residuals 0.0110848777
Durbin-Watson Statistic 1.947200

Variable	Coeff	Std Error	T-Stat	Signif
1. LNINVESTGBR{1}	-0.098043675	0.042443955	-2.30996	0.02514454
2. LNINVESTGBR{2}	0.084324007	0.037933815	2.22292	0.03086586
3. LNRGDPGBR{1}	-0.058274493	0.347167239	-0.16786	0.86738658
4. LNRGDPGBR{2}	0.124634737	0.333430748	0.37379	0.71016940
5. LNLABORPWGBR{1}	1.609983669	0.328915927	4.89482	0.00001109

6. LNLABORPWGBR{2}	-0.669920148	0.329676404	-2.03205	0.04758793
7. Constant	-0.409503703	0.990079342	-0.41361	0.68096668

F-Tests, Dependent Variable LNLABORPWGBR

Variable	F-Statistic	Signif
LNINVESTGBR	2.7550	0.0734747
LNRGDPGBR	0.2016	0.8181321
LNLABORPWGBR	25.4414	0.0000000

errors(model=gbrmodel,steps=24,cv=vgbr)

Decomposition of Variance for Series LNINVESTGBR

Step	Std Error	LNINVESTGBR	LNRGDPGBR	LNLABORPWGBR
1	0.06959177	100.000	0.000	0.000
2	0.09606174	89.069	9.808	1.123
3	0.11343320	83.828	14.013	2.159
4	0.12537162	80.830	16.311	2.858
5	0.13416375	78.900	17.841	3.259
6	0.14103392	77.449	19.082	3.469
7	0.14663326	76.226	20.201	3.574
8	0.15132928	75.124	21.253	3.623
9	0.15534956	73.133	23.207	3.660
11	0.16193920	72.215	24.117	3.669
12	0.16470603	71.339	24.983	3.678
13	0.16721483	70.502	25.809	3.689
14	0.16951676	69.701	26.596	3.703
15	0.17165194	68.931	27.349	3.720
16	0.17365196	68.191	28.069	3.740
17	0.17554186	67.479	28.759	3.762
18	0.17734151	66.791	29.421	3.787
19	0.17906679	66.127	30.058	3.814
20	0.18073042	65.485	30.672	3.843
21	0.18234264	64.864	31.264	3.873
22	0.18391173	64.261	31.835	3.904
23	0.18544438	63.677	32.387	3.936
24	0.18694604	63.110	32.922	3.968

Decomposition of Variance for Series LNRGDPGBR

Step	Std Error	LNINVESTGBR	LNRGDPGBR	LNLABORPWGBR
1	0.01476423	61.036	38.964	0.000
2	0.02444169	44.396	54.807	0.797
3	0.03157462	38.752	59.551	1.697
4	0.03716508	35.824	61.704	2.472
5	0.04182353	34.048	62.871	3.081
6	0.04590044	32.846	63.607	3.548
7	0.04958700	31.966	64.125	3.909
8	0.05299016	31.288	64.517	4.195
9	0.05617364	30.744	64.828	4.428
10	0.05917875	30.296	65.082	4.622
11	0.06203448	29.920	65.295	4.785
12	0.06476246	29.599	65.474	4.926
13	0.06737950	29.323	65.629	5.048
14	0.06989902	29.082	65.763	5.155
15	0.07233197	28.870	65.880	5.250
16	0.07468735	28.683	65.983	5.334

17	0.07697273	28.516	66.074	5.410
18	0.07919448	28.367	66.156	5.478
19	0.08135808	28.232	66.229	5.539
20	0.08346823	28.110	66.295	5.594
21	0.08552903	27.999	66.356	5.645
22	0.08754407	27.898	66.410	5.691
23	0.08951652	27.806	66.460	5.734
24	0.09144921	27.721	66.506	5.773

Decomposition of Variance for Series LNLABORPWGBR

Step	Std Error	LNINVESTGBR	LNRGDPGBR	LNLABORPWGBR
1	0.01406927	52.842	33.196	13.961
2	0.02250875	36.529	43.878	19.593
3	0.02835898	32.060	45.572	22.369
4	0.03285750	30.492	46.279	23.229
5	0.03663851	30.069	46.989	22.942
6	0.04001628	30.094	47.831	22.076
7	0.04313178	30.259	48.754	20.987
8	0.04604655	30.433	49.699	19.868
9	0.04879038	30.566	50.623	18.811
10	0.05138200	30.645	51.505	17.851
11	0.05383656	30.672	52.333	16.995
12	0.05616784	30.657	53.106	16.238
13	0.05838861	30.606	53.824	15.570
14	0.06051053	30.530	54.489	14.981
15	0.06254415	30.435	55.107	14.459
16	0.06449888	30.326	55.679	13.996
17	0.06638303	30.208	56.209	13.583
18	0.06820389	30.085	56.702	13.213
19	0.06996785	29.960	57.160	12.880
20	0.07168050	29.834	57.586	12.580
21	0.07334670	29.709	57.983	12.308
22	0.07497070	29.587	58.353	12.060
23	0.07655620	29.468	58.699	11.833
24	0.07810645	29.353	59.022	11.625

```
compute [vect[strings]] implabel=|| $
  "British Investment",$
  "British GDP",$
  "British Labor Productivity"||

@VARIRF(model=gbrmodel,steps=nsteps,vlabels=implabel,byshocks,byvariables)



* USA
* ____

Use Clear Program!

calendar(a) 1950
open data

* Penn 7 G7 col b.xls
```

```
data(format=xls,org=columns) / popusa rgdpchusa kiusa rgdpwokusa

set rgdpusa = rgdpchusa*popusa
set investusa = kiusa*rgdpusa

set lnrgdpusa = log(rgdpusa)
set lninvestusa = log(investusa)
set lnlaborpwusa = log(rgdpwokusa)

graph(key=upleft) 1
# lnrgdpusa
graph(key=upleft) 1
# lninvestusa
graph(key=upleft) 1
# lnlaborpwusa

compute  neqn   = 3
compute  nlags  = 2
compute  nsteps = 12

grparm(nopatterns)
grparm(bold) header 36
grparm axislabeling 27
grparm keylabeling 27

system(model=usamodel)
variables lninvestusa lnrgdpusa lnlaborpwusa
lags 1 to nlags
det constant
end(system)

estimate(cvout=vusa)
```

VAR/System - Estimation by Least Squares
Dependent Variable LNINVESTUSA
Annual Data From 1952:01 To 2007:01

Usable Observations	56	Degrees of Freedom	49
Mean of Dependent Variable		25.328451310	
Std Error of Dependent Variable		0.648296776	
Standard Error of Estimate		0.072617771	
Sum of Squared Residuals		0.2583936925	
Durbin-Watson Statistic		2.011798	

Variable	Coeff	Std Error	T-Stat	Signif
1. LNINVESTUSA{1}	0.557075064	0.288435827	1.93137	0.05923271
2. LNINVESTUSA{2}	-0.262449025	0.208262601	-1.26018	0.21357187
3. LNRGDPUSA{1}	-1.376308459	1.839071417	-0.74837	0.45781333
4. LNRGDPUSA{2}	1.989154880	1.760155949	1.13010	0.26393510
5. LNLABORPWUSA{1}	2.361346089	1.608508389	1.46803	0.14848515
6. LNLABORPWUSA{2}	-1.854596149	1.541146227	-1.20339	0.23460828
7. Constant	-1.350635572	0.632227345	-2.13631	0.03767425

F-Tests, Dependent Variable LNINVESTUSA

Variable	F-Statistic	Signif

LNINVESTUSA	1.8966	0.1609296
LNRGDPUSA	6.1192	0.0042435
LNLABORPWUSA	1.7533	0.1838848

Dependent Variable LNRGDPUSA
Annual Data From 1952:01 To 2007:01
Usable Observations 56 Degrees of Freedom 49
Mean of Dependent Variable 22.440452300
Std Error of Dependent Variable 0.528812885
Standard Error of Estimate 0.021894100
Sum of Squared Residuals 0.0234882283
Durbin-Watson Statistic 2.139537

Variable	Coeff	Std Error	T-Stat	Signif
1. LNINVESTUSA{1}	-0.099233748	0.086962773	-1.14111	0.25937214
2. LNINVESTUSA{2}	-0.006660139	0.062790720	-0.10607	0.91596078
3. LNRGDPUSA{1}	0.884162267	0.554476023	1.59459	0.11723444
4. LNRGDPUSA{2}	0.203992957	0.530683181	0.38440	0.70234755
5. LNLABORPWUSA{1}	0.492675243	0.484961772	1.01591	0.31466462
6. LNLABORPWUSA{2}	-0.413609865	0.464652228	-0.89015	0.37773547
7. Constant	-0.126825867	0.190615166	-0.66535	0.50894632

F-Tests, Dependent Variable LNRGDPUSA

Variable	F-Statistic	Signif
LNINVESTUSA	1.6492	0.2026862
LNRGDPUSA	152.7530	0.0000000
LNLABORPWUSA	0.6512	0.5258568

Dependent Variable LNLABORPWUSA
Annual Data From 1952:01 To 2007:01
Usable Observations 56 Degrees of Freedom 49
Mean of Dependent Variable 10.905589641
Std Error of Dependent Variable 0.251500632
Standard Error of Estimate 0.021324024
Sum of Squared Residuals 0.0222809856
Durbin-Watson Statistic 2.212136

Variable	Coeff	Std Error	T-Stat	Signif
1. LNINVESTUSA{1}	-0.078746632	0.084698447	-0.92973	0.35706908
2. LNINVESTUSA{2}	0.003544767	0.061155783	0.05796	0.95401391
3. LNRGDPUSA{1}	-0.795197730	0.540038645	-1.47248	0.14728507
4. LNRGDPUSA{2}	0.868399061	0.516865319	1.68013	0.09929823
5. LNLABORPWUSA{1}	2.047271515	0.472334398	4.33437	0.00007245
6. LNLABORPWUSA{2}	-1.013193506	0.452553671	-2.23884	0.02974081
7. Constant	-0.081737829	0.185651952	-0.44027	0.66167440

F-Tests, Dependent Variable LNLABORPWUSA

Variable	F-Statistic	Signif
LNINVESTUSA	0.8708	0.4250092
LNRGDPUSA	2.9260	0.0630353
LNLABORPWUSA	58.8770	0.0000000

errors(model=usamodel,steps=24,cv=vusa)

Decomposition of Variance for Series LNINVESTUSA

Step	Std Error	LNINVESTUSA	LNRGDPUSA	LNLABORPWUSA
1	0.06792770	100.000	0.000	0.000
2	0.08719728	97.386	1.228	1.386
3	0.09421923	91.708	4.320	3.972
4	0.09870795	86.126	7.710	6.165
5	0.10255479	82.085	10.392	7.523
6	0.10627313	79.331	12.364	8.305
7	0.10989212	77.299	13.917	8.784
8	0.11328805	75.616	15.274	9.110
9	0.11642280	74.143	16.522	9.335
10	0.11932930	72.845	17.680	9.475
11	0.12205203	71.705	18.751	9.544
12	0.12462317	70.700	19.743	9.557
13	0.12706288	69.804	20.668	9.527
14	0.12938535	68.997	21.536	9.467
15	0.13160266	68.262	22.355	9.383
16	0.13372575	67.586	23.131	9.282
17	0.13576441	66.963	23.868	9.169
18	0.13772705	66.383	24.569	9.048
19	0.13962088	65.842	25.237	8.921
20	0.14145210	65.334	25.876	8.790
21	0.14322605	64.856	26.487	8.658
22	0.14494744	64.404	27.071	8.525
23	0.14662037	63.976	27.632	8.392
24	0.14824848	63.568	28.170	8.261

Decomposition of Variance for Series LNRGDPUSA

Step	Std Error	LNINVESTUSA	LNRGDPUSA	LNLABORPWUSA
1	0.02048005	78.662	21.338	0.000
2	0.03012439	70.730	28.765	0.505
3	0.03641530	63.079	35.672	1.250
4	0.04131855	57.729	40.473	1.797
5	0.04558188	54.603	43.292	2.105
6	0.04946862	52.881	44.852	2.267
7	0.05304911	51.842	45.800	2.358
8	0.05635075	51.098	46.491	2.411
9	0.05940871	50.502	47.061	2.437
10	0.06226242	50.008	47.551	2.441
11	0.06494562	49.594	47.978	2.428
12	0.06748359	49.244	48.354	2.401
13	0.06989499	48.942	48.692	2.366
14	0.07219436	48.675	49.001	2.324
15	0.07439374	48.436	49.287	2.277
16	0.07650330	48.219	49.552	2.229
17	0.07853172	48.019	49.801	2.179
18	0.08048639	47.836	50.036	2.129
19	0.08237366	47.665	50.256	2.079
20	0.08419901	47.505	50.465	2.030
21	0.08596722	47.356	50.663	1.982
22	0.08768248	47.215	50.850	1.889
24	0.09096858	46.956	51.198	1.845

Decomposition of Variance for Series LNLABORPWUSA

Step	Std Error	LNINVESTUSA	LNRGDPUSA	LNLABORPWUSA
1	0.01994680	72.060	23.190	4.750
2	0.02908100	60.056	28.344	11.600
3	0.03528128	50.704	31.149	18.147
4	0.04014564	45.309	31.693	22.997
5	0.04427907	42.747	30.991	26.263
6	0.04791980	41.680	29.874	28.446
7	0.05113335	41.228	28.807	29.964
8	0.05395395	41.002	27.948	31.049
9	0.05642951	40.886	27.303	31.811
10	0.05861333	40.850	26.836	32.314
11	0.06055278	40.879	26.509	32.611
12	0.06228616	40.955	26.297	32.748
13	0.06384434	41.059	26.178	32.762
14	0.06525285	41.181	26.136	32.683
15	0.06653329	41.311	26.157	32.532
16	0.06770397	41.445	26.228	32.327
17	0.06878040	41.579	26.340	32.080
18	0.06977563	41.711	26.486	31.804
19	0.07070067	41.837	26.657	31.505
20	0.07156480	41.959	26.850	31.191
21	0.07237590	42.074	27.060	30.866
22	0.07314062	42.182	27.282	30.536
23	0.07386465	42.283	27.515	30.202
24	0.07455283	42.377	27.755	29.868

```
compute [vect[strings]] implabel=|| $
  "American Investment",$
  "American GDP",$
  "American Labor Productivity"||

@VARIRF(model=usamodel,steps=nsteps,vlabels=implabel,byshocks,byvariables)
```

B) Vector Error Correction Models

This section uses the program ECT.PRG of RATS 7.2 (RATS User's Guide, Example 10.6).

Variables are nonstationary and cointegrated in Australia, France and Japan. In the other countries the VECMs are inappropriate.

```
* Australia
* ________

* Use Clear Program!

calendar(a) 1950
open data

* Penn 7 G7 across.xls

data(format=xls,org=columns) / popaus rgdpchaus kiaus rgdpwokaus

set rgdpaus = rgdpchaus*popaus
set investaus = kiaus*rgdpaus

set lnrgdpaus = log(rgdpaus)
set lninvestaus = log(investaus)
set lnlaborpwaus = log(rgdpwokaus)

graph(key=upleft) 1
# lnrgdpaus
graph(key=upleft) 1
# lninvestaus
graph(key=upleft) 1
# lnlaborpwaus

@dfunit(lags=2) lnrgdpaus

Dickey-Fuller Unit Root Test, Series LNRGDPAUS
Regression Run From 1953:01 to 2009:01
Observations        58
With intercept
Using 2 lags on the differences

Sig Level       Crit Value
1%(**)          -3.54563
5%(*)           -2.91179
10%             -2.59322

T-Statistic     -2.56149

@dfunit(lags=2) lninvestaus

Dickey-Fuller Unit Root Test, Series LNINVESTAUS
Regression Run From 1953:01 to 2009:01
Observations        58
```

With intercept
Using 2 lags on the differences

Sig Level	Crit Value
1%(**)	-3.54563
5%(*)	-2.91179
10%	-2.59322

T-Statistic -0.23326

@dfunit(lags=2) lnlaborpwaus

Dickey-Fuller Unit Root Test, Series LNLABORPWAUS
Regression Run From 1953:01 to 2007:01
Observations 56
With intercept
Using 2 lags on the differences

Sig Level	Crit Value
1%(**)	-3.54995
5%(*)	-2.91366
10%	-2.59421

T-Statistic -1.48381

@johmle(lags=2,det=constant,cv=cvector)
lninvestaus lnrgdpaus lnlaborpwaus

Likelihood Based Analysis of Cointegration
Variables: LNINVESTAUS LNRGDPAUS LNLABORPWAUS
Estimated from 1952:01 to 2007:01
Data Points 56 Lags 2 with Constant

Unrestricted eigenvalues and -T log(1-lambda)

Rank	EigVal	Lambda-max	Trace	Trace-95%	LogL
0					414.5330
1	0.3415	23.3952	31.8495	29.8000	426.2306
2	0.1345	8.0920	8.4543	15.4100	430.2766
3	0.0064	0.3623	0.3623	3.8400	430.4578

Cointegrating Vector for Largest Eigenvalue

LNINVESTAUS	LNRGDPAUS	LNLABORPWAUS
-10.930932	0.636661	25.624356

equation(coeffs=cvector) ecteq *
lninvestaus lnrgdpaus lnlaborpwaus

system(model=ectmodel)
variables lninvestaus lnrgdpaus lnlaborpwaus
lags 1 to 2
det constant
ect ecteq
end(system)

estimate

VAR/System - Estimation by Cointegrated Least Squares
Dependent Variable LNINVESTAUS
Annual Data From 1952:01 To 2007:01
Usable Observations 56 Degrees of Freedom 51
Mean of Dependent Variable 0.0422482047
Std Error of Dependent Variable 0.1209219919
Standard Error of Estimate 0.1007564406
Sum of Squared Residuals 0.5177448766
Durbin-Watson Statistic 1.640865

Variable	Coeff	Std Error	T-Stat	Signif
1. D_LNINVESTAUS(1)	-0.869767764	0.228295515	-3.80983	0.00037537
2. D_LNRGDPAUS(1)	2.693711655	2.048142139	1.31520	0.19432626
3. D_LNLABORPWAUS(1)	1.104770495	1.826500991	0.60486	0.54795642
4. Constant	-1.550447264	0.562111778	-2.75825	0.00804728
5. EC1{1}	0.037430470	0.013464146	2.78001	0.00759457

Dependent Variable LNRGDPAUS
Annual Data From 1952:01 To 2007:01
Usable Observations 56 Degrees of Freedom 51
Mean of Dependent Variable 0.0386653687
Std Error of Dependent Variable 0.0251823872
Standard Error of Estimate 0.0220799177
Sum of Squared Residuals 0.0248636610
Durbin-Watson Statistic 1.892016

Variable	Coeff	Std Error	T-Stat	Signif
1. D_LNINVESTAUS(1)	-0.217400951	0.050029022	-4.34550	0.00006634
2. D_LNRGDPAUS(1)	0.633736356	0.448832944	1.41196	0.16403300
3. D_LNLABORPWAUS(1)	0.295894810	0.400262169	0.73925	0.46314275
4. Constant	-0.048614121	0.123182019	-0.39465	0.69474483
5. EC1{1}	0.001660215	0.002950553	0.56268	0.57611859

Dependent Variable LNLABORPWAUS
Annual Data From 1952:01 To 2007:01
Usable Observations 56 Degrees of Freedom 51
Mean of Dependent Variable 0.0189670408
Std Error of Dependent Variable 0.0261087377
Standard Error of Estimate 0.0235427831
Sum of Squared Residuals 0.0282673945
Durbin-Watson Statistic 2.010136

Variable	Coeff	Std Error	T-Stat	Signif
1. D_LNINVESTAUS(1)	-0.192926122	0.053343605	-3.61667	0.00068392
2. D_LNRGDPAUS(1)	0.361812981	0.478569568	0.75603	0.45310924
3. D_LNLABORPWAUS(1)	0.400192849	0.426780824	0.93770	0.35281767
4. Constant	-0.108233670	0.131343224	-0.82405	0.41374719
5. EC1{1}	0.002837613	0.003146037	0.90196	0.37131595

compute sigma=%sigma
errors(model=ectmodel,steps=24)

Decomposition of Variance for Series LNINVESTAUS

Step	Std Error	LNINVESTAUS	LNRGDPAUS	LNLABORPWAUS
1	0.09615323	100.000	0.000	0.000
2	0.12479676	84.857	13.570	1.574
3	0.14509437	80.278	17.138	2.584
4	0.16211273	77.844	18.923	3.233
5	0.17696010	75.929	20.309	3.761
6	0.19020291	74.371	21.410	4.220
7	0.20223633	73.061	22.314	4.626
8	0.21332638	71.927	23.081	4.992
9	0.22365899	70.927	23.747	5.326
10	0.23337007	70.036	24.332	5.632
11	0.24256190	69.233	24.853	5.913
12	0.25131319	68.506	25.321	6.173
13	0.25968570	67.843	25.744	6.413
14	0.26772872	67.237	26.127	6.636
15	0.27548211	66.680	26.478	6.843
16	0.28297855	66.167	26.799	7.035
17	0.29024511	65.693	27.094	7.213
18	0.29730448	65.254	27.366	7.380
19	0.30417579	64.847	27.617	7.535
20	0.31087538	64.469	27.851	7.680
21	0.31741728	64.116	28.067	7.816
22	0.32381362	63.787	28.269	7.943
23	0.33007500	63.480	28.458	8.062
24	0.33621069	63.192	28.634	8.174

Decomposition of Variance for Series LNRGDPAUS

Step	Std Error	LNINVESTAUS	LNRGDPAUS	LNLABORPWAUS
1	0.02107116	79.189	20.811	0.000
2	0.03189335	54.892	44.460	0.648
3	0.03988649	52.254	47.069	0.677
4	0.04709592	52.680	46.744	0.576
5	0.05383324	53.657	45.868	0.475
6	0.06019675	54.810	44.800	0.391
7	0.06625550	55.971	43.704	0.325
8	0.07205257	57.068	42.658	0.275
9	0.07761691	58.074	41.689	0.237
10	0.08297011	58.985	40.806	0.209
11	0.08812947	59.805	40.007	0.188
12	0.09310948	60.540	39.287	0.173
13	0.09792280	61.200	38.638	0.161
14	0.10258069	61.792	38.055	0.153
15	0.10709334	62.325	37.528	0.147
16	0.11147007	62.804	37.053	0.143
17	0.11571945	63.237	36.623	0.140
18	0.11984936	63.629	36.233	0.138
19	0.12386710	63.984	35.879	0.136
20	0.12777941	64.307	35.557	0.136
21	0.13159255	64.602	35.262	0.135
22	0.13531230	64.872	34.993	0.135
23	0.13894401	65.118	34.746	0.135
24	0.14249265	65.345	34.519	0.136

Decomposition of Variance for Series LNLABORPWAUS

Step	Std Error	LNINVESTAUS	LNRGDPAUS	LNLABORPWAUS
1	0.02246720	70.279	18.324	11.398
2	0.03333461	47.197	36.393	16.410
3	0.04091259	43.952	38.124	17.924
4	0.04746012	43.413	38.401	18.186
5	0.05338329	43.474	38.448	18.079
6	0.05883507	43.828	38.338	17.834
7	0.06392166	44.311	38.151	17.537
8	0.06871265	44.838	37.934	17.228
9	0.07325569	45.368	37.708	16.924
10	0.07758570	45.881	37.484	16.635
11	0.08172932	46.367	37.269	16.364
12	0.08570761	46.822	37.065	16.113
13	0.08953764	47.245	36.873	15.882
14	0.09323359	47.636	36.695	15.669
15	0.09680742	47.997	36.529	15.474
16	0.10026939	48.330	36.376	15.294
17	0.10362842	48.636	36.234	15.130
18	0.10689230	48.919	36.103	14.978
19	0.11006794	49.180	35.981	14.839
20	0.11316147	49.421	35.869	14.710
21	0.11617839	49.643	35.765	14.592
22	0.11912364	49.849	35.668	14.483
23	0.12200169	50.040	35.579	14.381
24	0.12481658	50.217	35.495	14.287

```
compute nsteps = 12

compute [vect[strings]] implabel=|| $
  "Australian Investment",$
  "Australian GDP",$
  "Australian Labor Productivity"||

grparm(nopatterns)
grparm(bold) header 36
grparm axislabeling 27
grparm keylabeling 27

@VARIRF(model=ectmodel,steps=nsteps,vlables=implabel,byshocks,byvariables)



* Canada
* _____

* Use Clear Program!

calendar(a) 1950
open data

* Penn 7 G7 across.xls

data(format=xls,org=columns) / popcan rgdpchcan kican rgdpwokcan
```

```
set rgdpcan = rgdpchcan*popcan
set investcan = kican*rgdpcan

set lnrgdpcan = log(rgdpcan)
set lninvestcan = log(investcan)
set lnlaborpwcan = log(rgdpwokcan)

graph(key=upleft) 1
# lnrgdpcan
graph(key=upleft) 1
# lninvestcan
graph(key=upleft) 1
# lnlaborpwcan

@dfunit(lags=2) lnrgdpcan

Dickey-Fuller Unit Root Test, Series LNRGDPCAN
Regression Run From 1953:01 to 2009:01
Observations          58
With intercept
Using 2 lags on the differences

Sig Level         Crit Value
1%(**)            -3.54563
5%(*)             -2.91179
10%               -2.59322

T-Statistic      -2.38654

@dfunit(lags=2) lninvestcan

Dickey-Fuller Unit Root Test, Series LNINVESTCAN
Regression Run From 1953:01 to 2009:01
Observations          58
With intercept
Using 2 lags on the differences

Sig Level         Crit Value
1%(**)            -3.54563
5%(*)             -2.91179
10%               -2.59322

T-Statistic      -0.76260

@dfunit(lags=2) lnlaborpwcan

Dickey-Fuller Unit Root Test, Series LNLABORPWCAN
Regression Run From 1953:01 to 2007:01
Observations          56
With intercept
Using 2 lags on the differences

Sig Level      Crit Value
1%(**)          -3.54995
5%(*)           -2.91366
```

10% -2.59421

T-Statistic -0.69397
@johmle(lags=2,det=constant,cv=cvector)
lninvestcan lnrgdpcan lnlaborpwcan

Likelihood Based Analysis of Cointegration
Variables: LNINVESTCAN LNRGDPCAN LNLABORPWCAN
Estimated from 1952:01 to 2007:01
Data Points 56 Lags 2 with Constant

Unrestricted eigenvalues and -T log(1-lambda)

Rank	EigVal	Lambda-max	Trace	Trace-95%	LogL
0					425.5518
1	0.2426	15.5614	27.9067	29.8000	433.3325
2	0.1493	9.0559	12.3453	15.4100	437.8605
3	0.0570	3.2894	3.2894	3.8400 4	39.5052

Cointegrating Vector for Largest Eigenvalue
LNINVESTCAN LNRGDPCAN LNLABORPWCAN
-10.347156 0.887710 25.440965

equation(coeffs=cvector) ecteq *
lninvestcan lnrgdpcan lnlaborpwcan

system(model=ectmodel)
variables lninvestcan lnrgdpcan lnlaborpwcan
lags 1 to 2
det constant
ect ecteq
end(system)

estimate

VAR/System - Estimation by Cointegrated Least Squares
Dependent Variable LNINVESTCAN
Annual Data From 1952:01 To 2007:01
Usable Observations 56 Degrees of Freedom 51
Mean of Dependent Variable 0.0418080311
Std Error of Dependent Variable 0.0853633925
Standard Error of Estimate 0.0816829220
Sum of Squared Residuals 0.3402770874
Durbin-Watson Statistic 1.974118

Variable	Coeff	Std Error	T-Stat	Signif
1. D_LNINVESTCAN(1)	-0.117229009	0.242230427	-0.48396	0.63048838
2. D_LNRGDPCAN(1)	-1.925014937	1.534892252	-1.25417	0.21549848
3. D_LNLABORPWCAN(1)	2.461865575	1.203881272	2.04494	0.04603759
4. Constant	-1.049712467	0.574903245	-1.82589	0.07372339
5. EC1{1}	0.020652181	0.010915340	1.89203	0.06417042

Dependent Variable LNRGDPCAN
Annual Data From 1952:01 To 2007:01
Usable Observations 56 Degrees of Freedom 51

Mean of Dependent Variable 0.0356179097
Std Error of Dependent Variable 0.0220667157
Standard Error of Estimate 0.0189155736
Sum of Squared Residuals 0.0182477452
Durbin-Watson Statistic 1.922828

Variable	Coeff	Std Error	T-Stat	Signif
1. D_LNINVESTCAN(1)	-0.050432024	0.056094069	-0.89906	0.37284524
2. D_LNRGDPCAN(1)	-0.113690679	0.355439872	-0.31986	0.75038185
3. D_LNLABORPWCAN(1)	0.474882417	0.278786609	1.70339	0.09458232
4. Constant	-0.356102726	0.133132170	-2.67481	0.01002393
5. EC1{1}	0.007145502	0.002527700	2.82688	0.00669809

Dependent Variable LNLABORPWCAN
Annual Data From 1952:01 To 2007:01
Usable Observations 56 Degrees of Freedom 51
Mean of Dependent Variable 0.0141519609
Std Error of Dependent Variable 0.0214415084
Standard Error of Estimate 0.0193221122
Sum of Squared Residuals 0.0190405449
Durbin-Watson Statistic 2.047327

Variable	Coeff	Std Error	T-Stat	Signif
1. D_LNINVESTCAN(1)	-0.075487647	0.057299658	-1.31742	0.19358640
2. D_LNRGDPCAN(1)	-0.530893538	0.363079081	-1.46220	0.14982214
3. D_LNLABORPWCAN(1)	0.894677336	0.284778365	3.14166	0.00279609
4. Constant	-0.201572052	0.135993482	-1.48222	0.14443526
5. EC1{1}	0.004110351	0.002582026	1.59191	0.11758511

compute sigma=%sigma
errors(model=ectmodel,steps=24)

Decomposition of Variance for Series LNINVESTCAN

Step	Std Error	LNINVESTCAN	LNRGDPCAN	LNLABORPWCAN
1	0.07795112	100.000	0.000	0.000
2	0.10335218	94.712	1.457	3.831
3	0.12093780	88.034	3.486	8.480
4	0.13544228	82.209	5.476	12.316
5	0.14819123	77.308	7.352	15.340
6	0.15975684	73.063	9.145	17.792
7	0.17046257	69.271	10.880	19.848
8	0.18051818	65.810	12.572	21.618
9	0.19006919	62.609	14.222	23.170
10	0.19922031	59.625	15.830	24.545
11	0.20804862	56.831	17.394	25.775
12	0.21661179	54.209	18.912	26.880
13	0.22495345	51.744	20.379	27.876
14	0.23310688	49.426	21.796	28.778
15	0.24109767	47.246	23.159	29.595
16	0.24894557	45.195	24.468	30.337
17	0.25666591	43.265	25.724	31.011
18	0.26427063	41.449	26.926	31.625
19	0.27176909	39.741	28.075	32.184

20	0.27916862	38.134	29.172	32.694
21	0.28647503	36.622	30.219	33.160
22	0.29369296	35.198	31.217	33.585
23	0.30082611	33.858	32.168	33.974
24	0.30787751	32.595	33.074	34.331

Decomposition of Variance for Series LNRGDPCAN

Step	Std Error	LNINVESTCAN	LNRGDPCAN	LNLABORPWCAN
1	0.01805139	57.996	42.004	0.000
2	0.02811546	38.790	58.708	2.502
3	0.03685831	26.201	68.603	5.196
4	0.04499285	18.401	74.491	7.108
5	0.05280082	13.464	78.156	8.381
6	0.06044024	10.279	80.485	9.236
7	0.06800082	8.231	81.945	9.824
8	0.07552964	6.954	82.812	10.235
9	0.08304830	6.211	83.265	10.524
10	0.09056381	5.844	83.428	10.727
11	0.09807518	5.743	83.388	10.869
12	0.10557726	5.827	83.206	10.966
13	0.11306293	6.041	82.928	11.031
14	0.12052438	6.344	82.586	11.071
15	0.12795384	6.705	82.202	11.092
16	0.13534396	7.104	81.795	11.101
17	0.14268803	7.524	81.376	11.099
18	0.14998006	7.955	80.955	11.091
19	0.15721483	8.387	80.536	11.077
20	0.16438783	8.816	80.125	11.059
21	0.17149523	9.237	79.725	11.038
22	0.17853385	9.647	79.338	11.015
23	0.18550110	10.045	78.964	10.992
24	0.19239489	10.428	78.604	10.967

Decomposition of Variance for Series LNLABORPWCAN

Step	Std Error	LNINVESTCAN	LNRGDPCAN	LNLABORPWCAN
1	0.01843935	46.645	39.868	13.487
2	0.02986993	26.318	47.999	25.683
3	0.03944010	17.526	50.712	31.762
4	0.04753334	13.233	51.874	34.892
5	0.05455736	10.811	52.515	36.674
6	0.06081727	9.278	52.933	37.789
7	0.06651328	8.222	53.237	38.542
8	0.07177572	7.447	53.473	39.080
9	0.07669243	6.852	53.665	39.483
10	0.08132518	6.379	53.827	39.794
11	0.08571927	5.992	53.967	40.041
12	0.08990901	5.669	54.090	40.241
13	0.09392113	5.394	54.200	40.406
14	0.09777694	5.157	54.298	40.544
15	0.10149374	4.950	54.388	40.661
16	0.10508582	4.767	54.471	40.761
17	0.10856516	4.605	54.547	40.848
18	0.11194186	4.459	54.618	40.923
19	0.11522463	4.327	54.684	40.989
20	0.11842094	4.208	54.745	41.047

```
   21  0.12153733      4.098          54.803          41.099
   22  0.12457954      3.998          54.857          41.145
   23  0.12755262      3.906          54.908          41.186
   24  0.13046109      3.821          54.956          41.223

compute nsteps = 12

compute [vect[strings]] implabel=|| $
  "Canadian Investment",$
  "Canadian GDP",$
  "Canadian Labor Productivity"||

grparm(nopatterns)
grparm(bold) header 36
grparm axislabeling 27
grparm keylabeling 27

@VARIRF(model=ectmodel,steps=nsteps,vlables=implabel,byshocks,byvariables)



* France
* _____


* Use Clear Program!

calendar(a) 1950
open data

* Penn 7 G7 across.xls

data(format=xls,org=columns) / popfra rgdpchfra kifra rgdpwokfra

set rgdpfra = rgdpchfra*popfra
set investfra = kifra*rgdpfra

set lnrgdpfra = log(rgdpfra)
set lninvestfra = log(investfra)
set lnlaborpwfra = log(rgdpwokfra)

graph(key=upleft) 1
# lnrgdpfra
graph(key=upleft) 1
# lninvestfra
graph(key=upleft) 1
# lnlaborpwfra

@dfunit(lags=2) lnrgdpfra

Dickey-Fuller Unit Root Test, Series LNRGDPFRA
Regression Run From 1953:01 to 2009:01
Observations          58
With intercept
Using 2 lags on the differences
```

Sig Level	Crit Value
1%(**)	-3.54563
5%(*)	-2.91179
10%	-2.59322

T-Statistic -3.38615*

@dfunit(lags=2) lninvestfra

Dickey-Fuller Unit Root Test, Series LNINVESTFRA
Regression Run From 1953:01 to 2009:01
Observations 58
With intercept
Using 2 lags on the differences

Sig Level	Crit Value
1%(**)	-3.54563
5%(*)	-2.91179
10%	-2.59322

T-Statistic -2.84219

@dfunit(lags=2) lnlaborpwfra

Dickey-Fuller Unit Root Test, Series LNLABORPWFRA
Regression Run From 1953:01 to 2007:01
Observations 56
With intercept
Using 2 lags on the differences

Sig Level	Crit Value
1%(**)	-3.54995
5%(*)	-2.91366
10%	-2.59421

T-Statistic -3.41120*

@johmle(lags=2,det=constant,cv=cvector)
lninvestfra lnrgdpfra lnlaborpwfra

Likelihood Based Analysis of Cointegration
Variables: LNINVESTFRA LNRGDPFRA LNLABORPWFRA
Estimated from 1952:01 to 2007:01
Data Points 56 Lags 2 with Constant

Unrestricted eigenvalues and -T log(1-lambda)

Rank	EigVal	Lambda-max	Trace	Trace-95%	LogL
0					496.3893
1	0.3389	23.1793	38.8834	29.8000	507.9789
2	0.2358	15.0625	15.7041	15.4100	515.5102
3	0.0114	0.6416	0.6416	3.8400	515.8310

Cointegrating Vector for Largest Eigenvalue
LNINVESTFRA LNRGDPFRA LNLABORPWFRA

-4.839980 -0.141296 10.238986

```
equation(coeffs=cvector) ecteq *
# lninvestfra lnrgdpfra lnlaborpwfra

system(model=ectmodel)
variables lninvestfra lnrgdpfra lnlaborpwfra
lags 1 to 2
det constant
ect ecteq
end(system)

estimate
```

VAR/System - Estimation by Cointegrated Least Squares
Dependent Variable LNINVESTFRA
Annual Data From 1952:01 To 2007:01
Usable Observations 56 Degrees of Freedom 51
Mean of Dependent Variable 0.0380314919
Std Error of Dependent Variable 0.0649053986
Standard Error of Estimate 0.0637975882
Sum of Squared Residuals 0.2075767451
Durbin-Watson Statistic 2.106372

Variable	Coeff	Std Error	T-Stat	Signif
1. D_LNINVESTFRA(1)	0.256010529	0.193960852	1.31991	0.19275973
2. D_LNRGDPFRA(1)	-3.254142536	2.427969036	-1.34027	0.18609702
3. D_LNLABORPWFRA(1)	2.813643090	2.693656669	1.04454	0.30115962
4. Constant	0.002764858	0.068269655	0.04050	0.96785338
5. EC1{1}	-0.006652164	0.008525311	-0.78028	0.43883032

Dependent Variable LNRGDPFRA
Annual Data From 1952:01 To 2007:01
Usable Observations 56 Degrees of Freedom 51
Mean of Dependent Variable 0.0330289620
Std Error of Dependent Variable 0.0200021742
Standard Error of Estimate 0.0160638039
Sum of Squared Residuals 0.0131603356
Durbin-Watson Statistic 1.988188

Variable	Coeff	Std Error	T-Stat	Signif
1. D_LNINVESTFRA(1)	0.031178605	0.048838039	0.63841	0.52606455
2. D_LNRGDPFRA(1)	-0.151803812	0.611346285	-0.24831	0.80489119
3. D_LNLABORPWFRA(1)	0.324379417	0.678244646	0.47826	0.63450678
4. Constant	-0.015725219	0.017189840	-0.91480	0.36460312
5. EC1{1}	-0.005011266	0.002146616	-2.33450	0.02354538

Dependent Variable LNLABORPWFRA
Annual Data From 1952:01 To 2007:01
Usable Observations 56 Degrees of Freedom 51
Mean of Dependent Variable 0.0267315364
Std Error of Dependent Variable 0.0195452394
Standard Error of Estimate 0.0142884534

Sum of Squared Residuals 0.0104121549
Durbin-Watson Statistic 2.031722

Variable	Coeff	Std Error	T-Stat	Signif
1. D_LNINVESTFRA(1)	0.039355353	0.043440523	0.90596	0.36921772
2. D_LNRGDPFRA(1)	-0.500298431	0.543781095	-0.92004	0.36188513
3. D_LNLABORPWFRA(1)	0.603370532	0.603285937	1.00014	0.32196450
4. Constant	-0.026952670	0.015290042	-1.76276	0.08393251
5. EC1{1}	-0.006006485	0.001909375	-3.14579	0.00276335

compute sigma=%sigma
errors(model=ectmodel,steps=24)

Decomposition of Variance for Series LNINVESTFRA

Step	Std Error	LNINVESTFRA	LNRGDPFRA	LNLABORPWFRA
1	0.06088290	100.000	0.000	0.000
2	0.09211354	98.479	0.826	0.695
3	0.11585175	96.445	2.152	1.403
4	0.13586177	94.706	3.402	1.892
5	0.15375819	93.374	4.426	2.200
6	0.17030999	92.358	5.250	2.392
7	0.18591777	91.558	5.928	2.514
8	0.20081165	90.904	6.505	2.591
9	0.21513747	90.350	7.010	2.639
10	0.22899539	89.868	7.464	2.669
11	0.24245817	89.438	7.877	2.685
12	0.25558074	89.050	8.258	2.692
13	0.26840559	88.694	8.614	2.692
14	0.28096633	88.366	8.947	2.687
15	0.29328991	88.060	9.261	2.679
16	0.30539828	87.774	9.559	2.667
17	0.31730953	87.504	9.842	2.654
18	0.32903872	87.249	10.111	2.640
19	0.34059855	87.007	10.368	2.624
20	0.35199979	86.777	10.615	2.608
21	0.36325169	86.558	10.851	2.591
22	0.37436223	86.349	11.077	2.574
23	0.38533835	86.149	11.294	2.557
24	0.39618615	85.957	11.503	2.540

Decomposition of Variance for Series LNRGDPFRA

Step	Std Error	LNINVESTFRA	LNRGDPFRA	LNLABORPWFRA
1	0.01532991	61.069	38.931	0.000
2	0.02474663	67.364	32.540	0.095
3	0.03208830	72.019	27.749	0.232
4	0.03828435	75.735	23.917	0.347
5	0.04385043	78.828	20.742	0.430
6	0.04905507	81.460	18.054	0.486
7	0.05404016	83.720	15.756	0.524
8	0.05888501	85.669	13.782	0.549
9	0.06363721	87.349	12.085	0.566
10	0.06832707	88.794	10.629	0.578
11	0.07297471	90.033	9.382	0.584
12	0.07759375	91.092	8.320	0.588

13	0.08219342	91.993	7.417	0.590
14	0.08677988	92.756	6.655	0.590
15	0.09135716	93.398	6.014	0.588
16	0.09592770	93.935	5.480	0.585
17	0.10049284	94.380	5.038	0.582
18	0.10505311	94.745	4.676	0.578
19	0.10960845	95.042	4.384	0.574
20	0.11415839	95.278	4.152	0.569
21	0.11870218	95.463	3.972	0.565
22	0.12323888	95.603	3.837	0.560
23	0.12776742	95.704	3.741	0.555
24	0.13228666	95.771	3.679	0.550

Decomposition of Variance for Series LNLABORPWFRA

Step	Std Error	LNINVESTFRA	LNRGDPFRA	LNLABORPWFRA
1	0.01363566	58.883	36.911	4.206
2	0.02175781	66.418	28.003	5.579
3	0.02811586	71.480	21.883	6.637
4	0.03359088	75.300	17.412	7.289
5	0.03863499	78.361	14.024	7.614
6	0.04346992	80.873	11.407	7.720
7	0.04820575	82.941	9.370	7.689
8	0.05289959	84.635	7.791	7.574
9	0.05758265	86.011	6.580	7.409
10	0.06227255	87.116	5.667	7.217
11	0.06697921	87.992	4.998	7.010
12	0.07170781	88.675	4.527	6.797
13	0.07646052	89.197	4.218	6.585
14	0.08123750	89.585	4.038	6.377
15	0.08603765	89.860	3.965	6.175
16	0.09085902	90.044	3.976	5.981
17	0.09569914	90.151	4.054	5.795
18	0.10055525	90.195	4.187	5.618
19	0.10542444	90.188	4.362	5.450
20	0.11030377	90.139	4.570	5.291
21	0.11519030	90.056	4.803	5.140
22	0.12008120	89.946	5.055	4.998
23	0.12497373	89.815	5.322	4.864
24	0.12986530	89.666	5.598	4.737

```
compute nsteps = 12

compute [vect[strings]] implabel=|| $
  "French Investment",$
  "French GDP",$
  "French Labor Productivity"||

grparm(nopatterns)
grparm(bold) header 36
grparm axislabeling 27
grparm keylabeling 27

@VARIRF(model=ectmodel,steps=nsteps,vlables=implabel,byshocks,byvariables)
```

```
* Germay
* _____

* Use Clear Program!

calendar(a) 1950
open data

* Penn 7 G7 across.xls

data(format=xls,org=columns) / popger rgdpchger kiger rgdpwokger

set rgdpger = rgdpchger*popger
set investger = kiger*rgdpger

set lnrgdpger = log(rgdpger)
set lninvestger = log(investger)
set lnlaborpwger = log(rgdpwokger)

graph(key=upleft) 1
# lnrgdpger
graph(key=upleft) 1
# lninvestger
graph(key=upleft) 1
# lnlaborpwger

@dfunit(lags=2) lnrgdpger

Dickey-Fuller Unit Root Test, Series LNRGDPGER
Regression Run From 1973:01 to 2009:01
Observations          38
With intercept
Using 2 lags on the differences

Sig Level         Crit Value
1%(**)            -3.61162
5%(*)             -2.93994
10%                -2.60804

T-Statistic      -1.85045

@dfunit(lags=2) lninvestger

Dickey-Fuller Unit Root Test, Series LNINVESTGER
Regression Run From 1973:01 to 2009:01
Observations          38
With intercept
Using 2 lags on the differences

Sig Level         Crit Value
1%(**)            -3.61162
5%(*)             -2.93994
10%               -2.60804
```

T-Statistic -0.99696

@dfunit(lags=2) lnlaborpwger

Dickey-Fuller Unit Root Test, Series LNLABORPWGER
Regression Run From 1973:01 to 2007:01
Observations 36
With intercept
Using 2 lags on the differences

Sig Level	Crit Value
1%(**)	-3.62271
5%(*)	-2.94461
10%	-2.61050

T-Statistic -1.13923

@johmle(lags=2,det=constant,cv=cvector)
lninvestger lnrgdpger lnlaborpwger

Likelihood Based Analysis of Cointegration
Variables: LNINVESTGER LNRGDPGER LNLABORPWGER
Estimated from 1972:01 to 2007:01
Data Points 36 Lags 2 with Constant

Unrestricted eigenvalues and -T log(1-lambda)

Rank	EigVal	Lambda-max	Trace	Trace-95%	LogL
0					308.0414
1	0.3394	14.9233	26.6755	29.8000	315.5031
2	0.2109	8.5286	11.7523	15.4100	319.7674
3	0.0857	3.2236	3.2236	3.8400	321.3792

Cointegrating Vector for Largest Eigenvalue

LNINVESTGER	LNRGDPGER	LNLABORPWGER
17.878756	-67.052692	70.850850

equation(coeffs=cvector) ecteq *
lninvestger lnrgdpger lnlaborpwger

system(model=ectmodel)
variables lninvestger lnrgdpger lnlaborpwger
lags 1 to 2
det constant
ect ecteq
end(system)

estimate

VAR/System - Estimation by Cointegrated Least Squares
Dependent Variable LNINVESTGER
Annual Data From 1972:01 To 2007:01
Usable Observations 36 Degrees of Freedom 31
Mean of Dependent Variable 0.0127517336
Std Error of Dependent Variable 0.0589040019
Standard Error of Estimate 0.0488489775

Sum of Squared Residuals 0.0739729007
Durbin-Watson Statistic 1.853205

Variable	Coeff	Std Error	T-Stat	Signif
1. D_LNINVESTGER(1)	0.301579199	0.264114392	1.14185	0.26225959
2. D_LNRGDPGER(1)	0.302969717	1.197523248	0.25300	0.80194079
3. D_LNLABORPWGER(1)	0.034288220	1.280029644	0.02679	0.97880128
4. Constant	-5.445992445	1.864490684	-2.92090	0.00645583
5. EC1{1}	-0.023921905	0.008141496	-2.93827	0.00618043

Dependent Variable LNRGDPGER
Annual Data From 1972:01 To 2007:01
Usable Observations 36 Degrees of Freedom 31
Mean of Dependent Variable 0.0208046409
Std Error of Dependent Variable 0.0166614783
Standard Error of Estimate 0.0148861276
Sum of Squared Residuals 0.0068695006
Durbin-Watson Statistic 1.889596

Variable	Coeff	Std Error	T-Stat	Signif
1. D_LNINVESTGER(1)	0.066256132	0.080485626	0.82320	0.41667976
2. D_LNRGDPGER(1)	0.498766138	0.364930543	1.36674	0.18153717
3. D_LNLABORPWGER(1)	-0.172090639	0.390073356	-0.44118	0.66214805
4. Constant	-0.689896998	0.568180700	-1.21422	0.23383247
5. EC1{1}	-0.003082361	0.002481021	-1.24238	0.22341442

Dependent Variable LNLABORPWGER
Annual Data From 1972:01 To 2007:01
Usable Observations 36 Degrees of Freedom 31
Mean of Dependent Variable 0.0149141745
Std Error of Dependent Variable 0.0168595302
Standard Error of Estimate 0.0161669156
Sum of Squared Residuals 0.0081024440
Durbin-Watson Statistic 1.920429

Variable	Coeff	Std Error	T-Stat	Signif
1. D_LNINVESTGER(1)	0.019773441	0.087410532	0.22621	0.82252033
2. D_LNRGDPGER(1)	0.221882748	0.396328814	0.55985	0.57960836
3. D_LNLABORPWGER(1)	0.240516378	0.423634891	0.56774	0.57429775
4. Constant	-0.839661219	0.617066419	-1.36073	0.18341047
5. EC1{1}	-0.003714935	0.002694486	-1.37872	0.17785025

compute sigma=%sigma
errors(model=ectmodel,steps=24)

Decomposition of Variance for Series LNINVESTGER

Step	Std Error	LNINVESTGER	LNRGDPGER	LNLABORPWGER
1	0.04532993	100.000	0.000	0.000
2	0.06365254	96.166	0.287	3.547
3	0.07425999	82.875	0.488	16.637
4	0.08488249	64.984	0.431	34.585
5	0.09639719	50.406	0.336	49.258

6	0.10740765	40.654	0.308	59.038
7	0.11717167	34.226	0.324	65.450
8	0.12571872	29.759	0.349	69.891
9	0.13335441	26.456	0.369	73.175
10	0.14037372	23.877	0.381	75.743
11	0.14697975	21.779	0.387	77.835
12	0.15329043	20.023	0.390	79.588
13	0.15936685	18.525	0.391	81.084
14	0.16523908	17.232	0.392	82.376
15	0.17092347	16.105	0.393	83.502
16	0.17643199	15.115	0.394	84.491
17	0.18177606	14.239	0.396	85.365
18	0.18696737	13.460	0.397	86.144
19	0.19201746	12.761	0.397	86.842
20	0.19693719	12.131	0.398	87.470
21	0.20173640	11.561	0.399	88.040
22	0.20642379	11.042	0.400	88.558
23	0.21100701	10.567	0.400	89.032
24	0.21549280	10.132	0.401	89.467

Decomposition of Variance for Series LNRGDPGER

Step	Std Error	LNINVESTGER	LNRGDPGER	LNLABORPWGER
1	0.01381374	76.017	23.983	0.000
2	0.02355831	74.720	23.848	1.432
3	0.03069038	69.869	24.865	5.266
4	0.03609458	63.406	25.688	10.906
5	0.04053694	57.035	25.995	16.970
6	0.04439575	51.704	25.961	22.336
7	0.04784490	47.603	25.809	26.588
8	0.05099354	44.553	25.658	29.789
9	0.05392306	42.283	25.544	32.172
10	0.05668963	40.554	25.466	33.980
11	0.05932786	39.188	25.414	35.399
12	0.06185806	38.066	25.377	36.557
13	0.06429284	37.117	25.348	37.535
14	0.06664126	36.297	25.324	38.379
15	0.06891083	35.578	25.303	39.119
16	0.07110825	34.943	25.284	39.773
17	0.07323964	34.379	25.267	40.354
18	0.07531051	33.875	25.252	40.873
19	0.07732575	33.423	25.238	41.339
20	0.07928970	33.016	25.225	41.759
21	0.08120611	32.646	25.213	42.140
22	0.08307833	32.310	25.203	42.487
23	0.08490929	32.003	25.193	42.804
24	0.08670160	31.720	25.185	43.095

Decomposition of Variance for Series LNLABORPWGER

Step	Std Error	LNINVESTGER	LNRGDPGER	LNLABORPWGER
1	0.01500226	62.327	14.517	23.156
2	0.02410011	63.582	18.875	17.544
3	0.02995768	63.315	23.183	13.502
4	0.03376238	62.044	27.068	10.888
5	0.03646576	60.357	30.309	9.334
6	0.03861509	58.701	32.915	8.384

7	0.04049164	57.283	35.006	7.711
8	0.04223771	56.144	36.700	7.156
9	0.04392021	55.243	38.091	6.666
10	0.04556317	54.522	39.253	6.226
11	0.04716963	53.926	40.242	5.833
12	0.04873595	53.417	41.099	5.484
13	0.05025903	52.971	41.854	5.175
14	0.05173842	52.573	42.526	4.901
15	0.05317585	52.214	43.129	4.657
16	0.05457423	51.890	43.672	4.438
17	0.05593672	51.596	44.163	4.241
18	0.05726630	51.329	44.609	4.062
19	0.05856551	51.085	45.017	3.898
20	0.05983650	50.861	45.390	3.749
21	0.06108111	50.656	45.733	3.611
22	0.06230092	50.467	46.049	3.484
23	0.06349734	50.292	46.341	3.367
24	0.06467165	50.130	46.613	3.258

```
compute nsteps = 12

compute [vect[strings]] implabel=|| $
  "German Investment",$
  "German GDP",$
  "German Labor Productivity"||

grparm(nopatterns)
grparm(bold) header 36
grparm axislabeling 27
grparm keylabeling 27

@VARIRF(model=ectmodel,steps=nsteps,vlables=implabel,byshocks,byvariables)



* Italy
* _____

* Use Clear Program!

calendar(a) 1950
open data

* Penn 7 G7 across.xls

data(format=xls,org=columns) / popita rgdpchita kiita rgdpwokita

set rgdpita = rgdpchita*popita
set investita = kiita*rgdpita

set lnrgdpita = log(rgdpita)
set lninvestita = log(investita)
set lnlaborpwita = log(rgdpwokita)

graph(key=upleft) 1
```

```
# lnrgdpita
graph(key=upleft) 1
# lninvestita
graph(key=upleft) 1
# lnlaborpwita

@dfunit(lags=2) lnrgdpita

Dickey-Fuller Unit Root Test, Series LNRGDPITA
Regression Run From 1953:01 to 2009:01
Observations         58
With intercept
Using 2 lags on the differences

Sig Level        Crit Value
1%(**)           -3.54563
5%(*)            -2.91179
10%              -2.59322

T-Statistic    -4.08772**

@dfunit(lags=2) lninvestita

Dickey-Fuller Unit Root Test, Series LNINVESTITA
Regression Run From 1953:01 to 2009:01
Observations         58
With intercept
Using 2 lags on the differences

Sig Level        Crit Value
1%(**)           -3.54563
5%(*)            -2.91179
10%              -2.59322

T-Statistic     -3.52978*

@dfunit(lags=2) lnlaborpwita

Dickey-Fuller Unit Root Test, Series LNLABORPWITA
Regression Run From 1953:01 to 2007:01
Observations         56
With intercept
Using 2 lags on the differences

Sig Level        Crit Value
1%(**)           -3.54995
5%(*)            -2.91366
10%              -2.59421

T-Statistic    -3.67688**

@johmle(lags=2,det=constant,cv=cvector)
# lninvestita lnrgdpita lnlaborpwita

Likelihood Based Analysis of Cointegration
```

Variables: LNINVESTITA LNRGDPITA LNLABORPWITA
Estimated from 1952:01 to 2007:01
Data Points 56 Lags 2 with Constant

Unrestricted eigenvalues and -T log(1-lambda)

Rank	EigVal	Lambda-max	Trace	Trace-95%	LogL
0					437.9269
1	0.2793	18.3396	38.0761	29.8000	447.0967
2	0.1977	12.3338	19.7365	15.4100	453.2635
3	0.1238	7.4027	7.4027	3.8400 4	56.9649

Cointegrating Vector for Largest Eigenvalue
LNINVESTITA LNRGDPITA LNLABORPWITA
7.237020 -22.444500 13.677178

equation(coeffs=cvector) ecteq *
lninvestita lnrgdpita lnlaborpwita

system(model=ectmodel)
variables lninvestita lnrgdpita lnlaborpwita
lags 1 to 2
det constant
ect ecteq
end(system)

estimate

VAR/System - Estimation by Cointegrated Least Squares
Dependent Variable LNINVESTITA
Annual Data From 1952:01 To 2007:01
Usable Observations 56 Degrees of Freedom 51
Mean of Dependent Variable 0.0372344148
Std Error of Dependent Variable 0.0745349742
Standard Error of Estimate 0.0755176831
Sum of Squared Residuals 0.2908489434
Durbin-Watson Statistic 1.991670

Variable	Coeff	Std Error	T-Stat	Signif
1. D_LNINVESTITA(1)	-0.356056155	0.271443537	-1.31171	0.19549109
2. D_LNRGDPITA(1)	1.265867215	1.565319083	0.80870	0.42244663
3. D_LNLABORPWITA(1)	0.233665277	1.064766381	0.21945	0.82717382
4. Constant	-1.009981873	1.495459063	-0.67537	0.50249417
5. EC1{1}	-0.006913807	0.010091475	-0.68511	0.49637446

Dependent Variable LNRGDPITA
Annual Data From 1952:01 To 2007:01
Usable Observations 56 Degrees of Freedom 51
Mean of Dependent Variable 0.0336026785
Std Error of Dependent Variable 0.0237686300
Standard Error of Estimate 0.0187735816
Sum of Squared Residuals 0.0179748156
Durbin-Watson Statistic 2.020743

Variable	Coeff	Std Error	T-Stat	Signif

1. D_LNINVESTITA(1)	-0.169732796	0.067480452	-2.51529	0.01508640
2. D_LNRGDPITA(1)	0.624053776	0.389135952	1.60369	0.11495804
3. D_LNLABORPWITA(1)	0.084786160	0.264699309	0.32031	0.75004112
4. Constant	0.460158610	0.371768857	1.23775	0.22147522
5. EC1{1}	0.003045023	0.002508725	1.21377	0.23042557

Dependent Variable LNLABORPWITA
Annual Data From 1952:01 To 2007:01
Usable Observations 56 Degrees of Freedom 51
Mean of Dependent Variable 0.0323209679
Std Error of Dependent Variable 0.0268766344
Standard Error of Estimate 0.0195529250
Sum of Squared Residuals 0.0194981607
Durbin-Watson Statistic 2.058115

Variable	Coeff	Std Error	T-Stat	Signif
1. D_LNINVESTITA(1)	-0.182567884	0.070281753	-2.59766	0.01223785
2. D_LNRGDPITA(1)	0.293532264	0.405290064	0.72425	0.47222034
3. D_LNLABORPWITA(1)	0.434505956	0.275687711	1.57608	0.12119083
4. Constant	0.627178955	0.387202013	1.61977	0.11144921
5. EC1{1}	0.004196021	0.002612870	1.60591	0.11446960

compute sigma=%sigma
errors(model=ectmodel,steps=24)

Decomposition of Variance for Series LNINVESTITA

Step	Std Error	LNINVESTITA	LNRGDPITA	LNLABORPWITA
1	0.07206755	100.000	0.000	0.000
2	0.09970857	98.574	1.411	0.016
3	0.12132079	97.346	2.613	0.041
4	0.14014604	96.523	3.403	0.074
5	0.15728560	95.978	3.905	0.117
6	0.17326935	95.604	4.229	0.167
7	0.18840322	95.334	4.441	0.226
8	0.20288397	95.129	4.580	0.291
9	0.21684716	94.967	4.671	0.362
10	0.23039069	94.832	4.728	0.440
11	0.24358780	94.717	4.761	0.522
12	0.25649474	94.616	4.775	0.609
13	0.26915566	94.523	4.777	0.700
14	0.28160581	94.437	4.768	0.794
15	0.29387377	94.356	4.752	0.892
16	0.30598296	94.278	4.730	0.992
17	0.31795282	94.202	4.703	1.095
18	0.32979959	94.127	4.673	1.199
19	0.34153696	94.054	4.640	1.306
20	0.35317658	93.981	4.605	1.414
21	0.36472835	93.908	4.569	1.523
22	0.37620080	93.836	4.531	1.633
23	0.38760126	93.763	4.493	1.744
24	0.39893611	93.691	4.454	1.856

Decomposition of Variance for Series LNRGDPITA

Step	Std Error	LNINVESTITA	LNRGDPITA	LNLABORPWITA
1	0.01791588	82.469	17.531	0.000
2	0.02747505	70.859	28.972	0.169
3	0.03603119	66.449	32.971	0.580
4	0.04417756	65.221	33.580	1.971
6	0.06024290	66.007	31.154	2.840
7	0.06839979	66.865	29.374	3.761
8	0.07671406	67.751	27.549	4.700
9	0.08521047	68.592	25.775	5.633
10	0.09390104	69.357	24.099	6.545
11	0.10279014	70.038	22.538	7.424
12	0.11187741	70.635	21.100	8.266
13	0.12115960	71.154	19.780	9.067
14	0.13063165	71.602	18.572	9.825
15	0.14028744	71.988	17.469	10.543
16	0.15012025	72.320	16.461	11.857
18	0.17028867	72.845	14.697	12.458
19	0.18061006	73.051	13.926	13.023
20	0.19108022	73.226	13.218	13.556
21	0.20169233	73.374	12.567	14.058
22	0.21243980	73.499	11.968	14.532
23	0.22331624	73.604	11.416	14.979
24	0.23431551	73.692	10.907	15.401

Decomposition of Variance for Series LNLABORPWITA

Step	Std Error	LNINVESTITA	LNRGDPITA	LNLABORPWITA
1	0.01865962	56.316	20.759	22.925
2	0.03000370	41.036	30.362	28.602
3	0.04043455	36.148	32.368	31.484
4	0.05046394	35.125	31.640	33.235
5	0.06039418	35.683	29.929	34.389
6	0.07039543	36.908	27.917	35.175
7	0.08055988	38.395	25.886	35.719
8	0.09093611	39.949	23.956	36.095
9	0.10154829	41.478	22.171	36.351
10	0.11240660	42.936	20.545	36.519
11	0.12351304	44.303	19.074	36.623
12	0.13486473	45.574	17.747	36.680
13	0.14645590	46.749	16.551	36.700
14	0.15827911	47.833	15.473	36.694
15	0.17032593	48.831	14.501	36.668
16	0.18258750	49.751	13.622	36.627
17	0.19505475	50.599	12.827	36.575
18	0.20771868	51.381	12.104	36.515
19	0.22057040	52.104	11.447	36.449
20	0.23360126	52.772	10.848	36.380
21	0.24680289	53.392	10.301	36.308
22	0.26016718	53.967	9.799	36.234
23	0.27368638	54.501	9.339	36.160
24	0.28735301	54.999	8.915	36.086

```
compute nsteps = 12

compute [vect[strings]] implabel=|| $
  "Italian Investment",$
```

```
  "Italian GDP",$
  "Italian Labor Productivity"||

grparm(nopatterns)
grparm(bold) header 36
grparm axislabeling 27
grparm keylabeling 27

@VARIRF(model=ectmodel,steps=nsteps,vlables=implabel,byshocks,byvariables)



* Japan
* _____


* Use Clear Program!

calendar(a) 1950
open data

* Penn 7 G7 across.xls

data(format=xls,org=columns) / popjpn rgdpchjpn kijpn rgdpwokjpn

set rgdpjpn = rgdpchjpn*popjpn
set investjpn = kijpn*rgdpjpn

set lnrgdpjpn = log(rgdpjpn)
set lninvestjpn = log(investjpn)
set lnlaborpwjpn = log(rgdpwokjpn)

graph(key=upleft) 1
# lnrgdpjpn
graph(key=upleft) 1
# lninvestjpn
graph(key=upleft) 1
# lnlaborpwjpn

@dfunit(lags=2) lnrgdpjpn

Dickey-Fuller Unit Root Test, Series LNRGDPJPN
Regression Run From 1953:01 to 2009:01
Observations          58
With intercept
Using 2 lags on the differences

Sig Level        Crit Value
1%(**)           -3.54563
5%(*)            -2.91179
10%              -2.59322

T-Statistic      -2.76420

@dfunit(lags=2) lninvestjpn
```

Dickey-Fuller Unit Root Test, Series LNINVESTJPN
Regression Run From 1953:01 to 2009:01
Observations 58
With intercept
Using 2 lags on the differences

Sig Level	Crit Value
1%(**)	-3.54563
5%(*)	-2.91179
10%	-2.59322

T-Statistic -4.22033**

@dfunit(lags=2) lnlaborpwjpn

Dickey-Fuller Unit Root Test, Series LNLABORPWJPN
Regression Run From 1953:01 to 2007:01
Observations 56
With intercept
Using 2 lags on the differences

Sig Level	Crit Value
1%(**)	-3.54995
5%(*)	-2.91366
10%	-2.59421

T-Statistic -2.45773

@johmle(lags=2,det=constant,cv=cvector)
lninvestjpn lnrgdpjpn lnlaborpwjpn

Likelihood Based Analysis of Cointegration
Variables: LNINVESTJPN LNRGDPJPN LNLABORPWJPN
Estimated from 1952:01 to 2007:01
Data Points 56 Lags 2 with Constant

Unrestricted eigenvalues and -T log(1-lambda)

Rank	EigVal	Lambda-max	Trace	Trace-95%	LogL
0					421.6950
1	0.3166	21.3202	30.1525	29.8000	432.3551
2	0.1049	6.2055	8.8324	15.4100	435.4578
3	0.0458	2.6269	2.6269	3.8400	436.7712

Cointegrating Vector for Largest Eigenvalue
LNINVESTJPN LNRGDPJPN LNLABORPWJPN
3.722895 -9.596783 3.941350

equation(coeffs=cvector) ecteq *
lninvestjpn lnrgdpjpn lnlaborpwjpn

system(model=ectmodel)
variables lninvestjpn lnrgdpjpn lnlaborpwjpn
lags 1 to 2
det constant

ect ecteq
end(system)

estimate

VAR/System - Estimation by Cointegrated Least Squares
Dependent Variable LNINVESTJPN
Annual Data From 1952:01 To 2007:01
Usable Observations 56 Degrees of Freedom 51
Mean of Dependent Variable 0.0536977230
Std Error of Dependent Variable 0.0878229174
Standard Error of Estimate 0.0771549974
Sum of Squared Residuals 0.3035975749
Durbin-Watson Statistic 1.324520

Variable	Coeff	Std Error	T-Stat	Signif
1. D_LNINVESTJPN(1)	-0.138613254	0.157408875	-0.88059	0.38266881
2. D_LNRGDPJPN(1)	-0.675810593	1.596293347	-0.42336	0.67381096
3. D_LNLABORPWJPN(1)	2.014857096	1.567418267	1.28546	0.20443747
4. Constant	0.670656986	0.759724292	0.88276	0.38150613
5. EC1{1}	0.009138034	0.010310270	0.88630	0.37961403

Dependent Variable LNRGDPJPN
Annual Data From 1952:01 To 2007:01
Usable Observations 56 Degrees of Freedom 51
Mean of Dependent Variable 0.0482705703
Std Error of Dependent Variable 0.0375427836
Standard Error of Estimate 0.0223055239
Sum of Squared Residuals 0.0253743563
Durbin-Watson Statistic 1.787903

Variable	Coeff	Std Error	T-Stat	Signif
1. D_LNINVESTJPN(1)	0.032007918	0.045506935	0.70336	0.48502800
2. D_LNRGDPJPN(1)	-0.632947588	0.461488700	-1.37153	0.17621276
3. D_LNLABORPWJPN(1)	1.033180454	0.453140909	2.28004	0.02681831
4. Constant	0.852347205	0.219636432	3.88072	0.00030012
5. EC1{1}	0.011380114	0.002980701	3.81793	0.00036593

Dependent Variable LNLABORPWJPN
Annual Data From 1952:01 To 2007:01
Usable Observations 56 Degrees of Freedom 51
Mean of Dependent Variable 0.0386879453
Std Error of Dependent Variable 0.0335539113
Standard Error of Estimate 0.0212642800
Sum of Squared Residuals 0.0230606498
Durbin-Watson Statistic 1.851307

Variable	Coeff	Std Error	T-Stat	Signif
1. D_LNINVESTJPN(1)	0.036280394	0.043382626	0.83629	0.40689394
2. D_LNRGDPJPN(1)	-0.974647071	0.439945951	-2.21538	0.03122543
3. D_LNLABORPWJPN(1)	1.328934602	0.431987843	3.07632	0.00336593
4. Constant	0.757620337	0.209383586	3.61834	0.00068043

5. EC1{1} 0.010122773 0.002841559 3.56240 0.00080731

```
compute sigma=%sigma
errors(model=ectmodel,steps=24)
```

Decomposition of Variance for Series LNINVESTJPN

Step	Std Error	LNINVESTJPN	LNRGDPJPN	LNLABORPWJPN
1	0.07363006	100.000	0.000	0.000
2	0.11265130	96.672	2.121	3.148
4	0.18055017	92.542	2.613	4.845
5	0.20980773	91.389	2.496	6.115
6	0.23709782	90.641	2.329	7.030
7	0.26300562	90.155	2.151	7.694
8	0.28792101	89.832	1.978	8.190
9	0.31210757	89.613	1.815	8.573
10	0.33574436	89.460	1.663	8.877
11	0.35895662	89.351	1.524	9.125
12	0.38183463	89.271	1.396	9.332
13	0.40444530	89.212	1.280	9.508
14	0.42683936	89.167	1.173	9.660
15	0.44905597	89.132	1.077	9.791
16	0.47112573	89.103	0.989	9.907
17	0.49307279	89.080	0.910	10.010
18	0.51491633	89.059	0.839	10.102
19	0.53667169	89.041	0.774	10.184
20	0.55835111	89.025	0.716	10.259
21	0.57996444	89.009	0.664	10.327
22	0.60151956	88.994	0.617	10.388
23	0.62302276	88.980	0.576	10.445
24	0.64447905	88.965	0.538	10.497

Decomposition of Variance for Series LNRGDPJPN

Step	Std Error	LNINVESTJPN	LNRGDPJPN	LNLABORPWJPN
1	0.02128646	55.861	44.139	0.000
2	0.03785036	60.605	36.440	2.955
3	0.05265226	62.125	31.347	6.528
4	0.06605934	63.264	27.398	9.338
5	0.07846491	64.426	24.256	11.317
6	0.09021390	65.655	21.666	12.679
7	0.10155451	66.903	19.472	13.625
8	0.11265275	68.127	17.577	14.297
9	0.12361597	69.298	15.917	14.784
10	0.13451344	70.402	14.452	15.146
11	0.14539042	71.432	13.150	15.418
12	0.15627695	72.387	11.989	15.625
13	0.16719318	73.269	10.950	15.781
14	0.17815264	74.083	10.018	15.899
15	0.18916431	74.833	9.180	15.988
16	0.20023390	75.522	8.425	16.053
17	0.21136476	76.158	7.744	16.099
18	0.22255853	76.742	7.129	16.129
19	0.23381558	77.281	6.572	16.148
20	0.24513532	77.777	6.067	16.156
21	0.25651646	78.234	5.610	16.156
22	0.26795722	78.656	5.194	16.150

23	0.27945541	79.046	4.816	16.138
24	0.29100859	79.407	4.472	16.121

Decomposition of Variance for Series LNLABORPWJPN

Step	Std Error	LNINVESTJPN	LNRGDPJPN	LNLABORPWJPN
1	0.02029279	48.428	42.726	8.845
2	0.03685076	49.832	32.435	17.733
3	0.05167292	49.424	26.893	23.683
4	0.06495655	49.490	23.128	27.382
5	0.07707469	50.012	20.373	29.615
6	0.08839028	50.843	18.217	30.940
7	0.09917247	51.847	16.446	31.707
8	0.10960441	52.933	14.942	32.124
9	0.11980657	54.044	13.636	32.320
10	0.12985843	55.146	12.485	32.369
11	0.13981347	56.221	11.460	32.319
12	0.14970860	57.258	10.541	32.201
13	0.15956987	58.251	9.714	32.035
14	0.16941602	59.197	8.966	31.836
15	0.17926061	60.098	8.288	31.614
16	0.18911351	60.952	7.672	31.376
17	0.19898183	61.761	7.111	31.127
18	0.20887061	62.528	6.600	30.872
19	0.21878332	63.253	6.133	30.614
20	0.22872224	63.940	5.706	30.354
21	0.23868871	64.589	5.315	30.096
22	0.24868333	65.203	4.957	29.840
23	0.25870616	65.785	4.628	29.587
24	0.26875683	66.336	4.326	29.338

```
compute nsteps = 12

compute [vect[strings]] implabel=|| $
  "Japanese Investment",$
  "Japanese GDP",$
  "Japanese Labor Productivity"||

grparm(nopatterns)
grparm(bold) header 36
grparm axislabeling 27
grparm keylabeling 27

@VARIRF(model=ectmodel,steps=nsteps,vlables=implabel,byshocks,byvariables)



* United Kingdom
* ———————

* Use Clear Program!

calendar(a) 1950
open data

* Penn 7 G7 across.xls
```

```
data(format=xls,org=columns) / popgbr rgdpchgbr kigbr rgdpwokgbr

set rgdpgbr = rgdpchgbr*popgbr
set investgbr = kigbr*rgdpgbr

set lnrgdpgbr = log(rgdpgbr)
set lninvestgbr = log(investgbr)
set lnlaborpwgbr = log(rgdpwokgbr)

graph(key=upleft) 1
# lnrgdpgbr
graph(key=upleft) 1
# lninvestgbr
graph(key=upleft) 1
# lnlaborpwgbr

@dfunit(lags=2) lnrgdpgbr

Dickey-Fuller Unit Root Test, Series LNRGDPGBR
Regression Run From 1953:01 to 2009:01
Observations        58
With intercept
Using 2 lags on the differences

Sig Level       Crit Value
1%(**)          -3.54563
5%(*)           -2.91179
10%             -2.59322

T-Statistic     -1.26506

@dfunit(lags=2) lninvestgbr

Dickey-Fuller Unit Root Test, Series LNINVESTGBR
Regression Run From 1953:01 to 2009:01
Observations        58
With intercept
Using 2 lags on the differences

Sig Level       Crit Value
1%(**)          -3.54563
5%(*)           -2.91179
10%             -2.59322

T-Statistic     -2.30670

@dfunit(lags=2) lnlaborpwgbr

Dickey-Fuller Unit Root Test, Series LNLABORPWGBR
Regression Run From 1953:01 to 2007:01
Observations        56
With intercept
Using 2 lags on the differences
```

Sig Level	Crit Value
1%(**)	-3.54995
5%(*)	-2.91366
10%	-2.59421

T-Statistic -0.09602

@johmle(lags=2,det=constant,cv=cvector)
lninvestgbr lnrgdpgbr lnlaborpwgbr

Likelihood Based Analysis of Cointegration
Variables: LNINVESTGBR LNRGDPGBR LNLABORPWGBR
Estimated from 1952:01 to 2007:01
Data Points 56 Lags 2 with Constant

Unrestricted eigenvalues and -T log(1-lambda)

Rank	EigVal	Lambda-max	Trace	Trace-95%	LogL
0					459.7908
1	0.1449	8.7680	14.8692	29.8000	464.1748
2	0.1030	6.0884	6.1013	15.4100	467.2190
3	0.0002	0.0129	0.0129	3.8400	467.2254

Cointegrating Vector for Largest Eigenvalue

LNINVESTGBR	LNRGDPGBR	LNLABORPWGBR
9.828885	9.673948	-26.371862

equation(coeffs=cvector) ecteq *
lninvestgbr lnrgdpgbr lnlaborpwgbr

system(model=ectmodel)
variables lninvestgbr lnrgdpgbr lnlaborpwgbr
lags 1 to 2
det constant
ect ecteq
end(system)

estimate

VAR/System - Estimation by Cointegrated Least Squares
Dependent Variable LNINVESTGBR
Annual Data From 1952:01 To 2007:01
Usable Observations 56 Degrees of Freedom 51
Mean of Dependent Variable 0.0343635991
Std Error of Dependent Variable 0.0797253660
Standard Error of Estimate 0.0732815528
Sum of Squared Residuals 0.2738794850
Durbin-Watson Statistic 1.496840

Variable	Coeff	Std Error	T-Stat	Signif
1. D_LNINVESTGBR(1)	-0.454789087	0.179127864	-2.53891	0.01421353
2. D_LNRGDPGBR(1)	1.399852952	1.614571920	0.86701	0.38999658
3. D_LNLABORPWGBR(1)	1.594989011	1.574237113	1.01318	0.31575595
4. Constant	3.491767336	1.485020530	2.35133	0.02260860
5. EC1{1}	-0.023069042	0.009792659	-2.35575	0.02236804

Dependent Variable LNRGDPGBR
Annual Data From 1952:01 To 2007:01
Usable Observations 56 Degrees of Freedom 51
Mean of Dependent Variable 0.0248296096
Std Error of Dependent Variable 0.0165518948
Standard Error of Estimate 0.0154752011
Sum of Squared Residuals 0.0122135744
Durbin-Watson Statistic 1.821677

Variable	Coeff	Std Error	T-Stat	Signif
1. D_LNINVESTGBR(1)	-0.092500645	0.037827251	-2.44534	0.01796356
2. D_LNRGDPGBR(1)	0.365796642	0.340956547	1.07285	0.28838695
3. D_LNLABORPWGBR(1)	0.339110658	0.332438861	1.02007	0.31251029
4. Constant	0.386580545	0.313598587	1.23272	0.22333111
5. EC1{1}	-0.002462106	0.002067961	-1.19060	0.23932448

Dependent Variable LNLABORPWGBR
Annual Data From 1952:01 To 2007:01
Usable Observations 56 Degrees of Freedom 51
Mean of Dependent Variable 0.0205415669
Std Error of Dependent Variable 0.0154977316
Standard Error of Estimate 0.0148039977
Sum of Squared Residuals 0.0111770757
Durbin-Watson Statistic 1.930390

Variable	Coeff	Std Error	T-Stat S	ignif
1. D_LNINVESTGBR(1)	-0.081720078	0.036186576	-2.25830	0.02823440
2. D_LNRGDPGBR(1)	-0.116809840	0.326168293	-0.35813	0.72172598
3. D_LNLABORPWGBR(1)	0.628107043	0.318020043	1.97505	0.05368674
4. Constant	0.191621275	0.299996925	0.63874	0.52584771
5. EC1{1}	-0.001170886	0.001978267	-0.59187	0.55654957

compute sigma=%sigma
errors(model=ectmodel,steps=24)

Decomposition of Variance for Series LNINVESTGBR

Step	Std Error	LNINVESTGBR	LNRGDPGBR	LNLABORPWGBR
1	0.06993358	100.000	0.000	0.000
2	0.09626373	89.645	8.793	1.562
3	0.11412664	84.062	12.428	3.511
4	0.12673268	80.604	14.062	5.334
5	0.13631516	78.203	14.861	6.937
6	0.14407346	76.304	15.332	8.364
7	0.15064448	74.673	15.657	9.670
8	0.15638632	73.208	15.904	10.888
9	0.16151889	71.861	16.100	12.038
10	0.16618860	70.611	16.259	13.130
11	0.17049845	69.440	16.390	14.170
12	0.17452346	68.342	16.499	15.160
13	0.17831936	67.306	16.590	16.103
14	0.18192824	66.329	16.669	17.002
15	0.18538226	65.405	16.736	17.859

16	0.18870633	64.530	16.795	18.675
17	0.19191994	63.701	16.846	19.452
18	0.19503852	62.915	16.892	20.193
19	0.19807440	62.167	16.933	20.900
20	0.20103752	61.457	16.970	21.573
21	0.20393599	60.781	17.003	22.215
22	0.20677645	60.138	17.034	22.828
23	0.20956439	59.525	17.062	23.413
24	0.21230441	58.941	17.088	23.971

Decomposition of Variance for Series LNRGDPGBR

Step	Std Error	LNINVESTGBR	LNRGDPGBR	LNLABORPWGBR
1	0.01476819	60.141	39.859	0.000
2	0.02449194	43.423	55.766	0.811
3	0.03167640	37.808	60.579	1.614
4	0.03727856	34.994	62.799	2.207
5	0.04193852	33.326	64.901	2.903
7	0.04970623	31.356	65.529	3.114
8	0.05310533	30.693	66.029	3.277
9	0.05627643	30.149	66.790	3.519
11	0.06208733	29.299	67.088	3.612
12	0.06477982	28.960	67.348	3.692
13	0.06735593	28.662	67.575	3.763
14	0.06983007	28.399	67.777	3.824
15	0.07221393	28.165	67.956	3.879
16	0.07451714	27.955	68.117	3.928
17	0.07674774	27.766	68.262	3.972
18	0.07891249	27.595	68.393	4.012
19	0.08101717	27.439	68.513	4.048
20	0.08306673	27.297	68.622	4.081
21	0.08506547	27.167	68.722	4.111
22	0.08701715	27.048	68.813	4.164
24	0.09079215	26.837	68.976	4.188

Decomposition of Variance for Series LNLABORPWGBR

Step	Std Error	LNINVESTGBR	LNRGDPGBR	LNLABORPWGBR
1	0.01412766	53.192	31.870	14.938
2	0.02257110	37.116	40.925	21.959
3	0.02863200	32.473	41.204	26.323
4	0.03345447	30.650	40.435	28.914
5	0.03762348	29.966	39.663	30.371
6	0.04141377	29.781	39.063	31.156
7	0.04494623	29.825	38.614	31.561
8	0.04827740	29.974	38.272	31.753
9	0.05143903	30.172	38.003	31.826
10	0.05445310	30.388	37.783	31.829
11	0.05733676	30.608	37.600	31.792
12	0.06010410	30.823	37.445	31.732
13	0.06276684	31.028	37.312	31.660
14	0.06533491	31.222	37.197	31.581
15	0.06781677	31.403	37.096	31.501
16	0.07021971	31.572	37.007	31.422
17	0.07255010	31.728	36.927	31.344
18	0.07481354	31.873	36.857	31.270
19	0.07701495	32.007	36.793	31.200

```
    20   0.07915877      32.131          36.736          31.133
    21   0.08124892      32.245          36.684          31.071
    22   0.08328895      32.351          36.637          31.012
    23   0.08528206      32.450          36.593          30.957
    24   0.08723115      32.541          36.554          30.906

compute nsteps = 12

compute [vect[strings]] implabel=|| $
  "British Investment",$
  "British GDP",$
  "British Labor Productivity"||

grparm(nopatterns)
grparm(bold) header 36
grparm axislabeling 27
grparm keylabeling 27

@VARIRF(model=ectmodel,steps=nsteps,vlables=implabel,byshocks,byvariables)



* USA
* ____

* Use Clear Program!

calendar(a) 1950
open data

* Penn 7 G7 across.xls

data(format=xls,org=columns) / popusa rgdpchusa kiusa rgdpwokusa

set rgdpusa = rgdpchusa*popusa
set investusa = kiusa*rgdpusa

set lnrgdpusa = log(rgdpusa)
set lninvestusa = log(investusa)
set lnlaborpwusa = log(rgdpwokusa)

graph(key=upleft) 1
# lnrgdpusa
graph(key=upleft) 1
# lninvestusa
graph(key=upleft) 1
# lnlaborpwusa

@dfunit(lags=2) lnrgdpusa

Dickey-Fuller Unit Root Test, Series LNRGDPUSA
Regression Run From 1953:01 to 2009:01
Observations          58
With intercept
Using 2 lags on the differences
```

Sig Level	Crit Value
1%(**)	-3.54563
5%(*)	-2.91179
10%	-2.59322

T-Statistic -1.29111

@dfunit(lags=2) lninvestusa

Dickey-Fuller Unit Root Test, Series LNINVESTUSA
Regression Run From 1953:01 to 2009:01
Observations 58
With intercept
Using 2 lags on the differences

Sig Level	Crit Value
1%(**)	-3.54563
5%(*)	-2.91179
10%	-2.59322

T-Statistic -1.27172

@dfunit(lags=2) lnlaborpwusa

Dickey-Fuller Unit Root Test, Series LNLABORPWUSA
Regression Run From 1953:01 to 2007:01
Observations 56
With intercept
Using 2 lags on the differences

Sig Level	Crit Value
1%(**)	-3.54995
5%(*)	-2.91366
10%	-2.59421

T-Statistic -0.16354

@johmle(lags=2,det=constant,cv=cvector)
lninvestusa lnrgdpusa lnlaborpwusa

Likelihood Based Analysis of Cointegration
Variables: LNINVESTUSA LNRGDPUSA LNLABORPWUSA
Estimated from 1952:01 to 2007:01
Data Points 56 Lags 2 with Constant

Unrestricted eigenvalues and -T log(1-lambda)

Rank	EigVal	Lambda-max	Trace	Trace-95%	LogL
0					464.9369
1	0.3328	22.6581	25.6395	29.8000	476.2660
2	0.0470	2.6985	2.9814	15.4100	477.6152
3	0.0050	0.2829	0.2829	3.8400	477.7567

Cointegrating Vector for Largest Eigenvalue
LNINVESTUSA LNRGDPUSA LNLABORPWUSA

19.969174 -16.600315 -16.224399

```
equation(coeffs=cvector) ecteq *
# lninvestusa lnrgdpusa lnlaborpwusa

system(model=ectmodel)
variables lninvestusa lnrgdpusa lnlaborpwusa
lags 1 to 2
det constant
ect ecteq
end(system)

estimate
```

VAR/System - Estimation by Cointegrated Least Squares
Dependent Variable LNINVESTUSA
Annual Data From 1952:01 To 2007:01
Usable Observations 56 Degrees of Freedom 51
Mean of Dependent Variable 0.0363094515
Std Error of Dependent Variable 0.0800793332
Standard Error of Estimate 0.0712622406
Sum of Squared Residuals 0.2589936537
Durbin-Watson Statistic 2.009029

Variable	Coeff	Std Error	T-Stat	Signif
1. D_LNINVESTUSA(1)	0.246987482	0.196117470	1.25939	0.21362458
2. D_LNRGDPUSA(1)	-1.983074590	1.657417140	-1.19648	0.23704013
3. D_LNLABORPWUSA(1)	1.875160484	1.486717127	1.26128	0.21294840
4. Constant	-1.478994561	0.425908895	-3.47256	0.00105954
5. EC1{1}	-0.035302289	0.009522817	-3.70713	0.00051734

Dependent Variable LNRGDPUSA
Annual Data From 1952:01 To 2007:01
Usable Observations 56 Degrees of Freedom 51
Mean of Dependent Variable 0.0320460920
Std Error of Dependent Variable 0.0217043942
Standard Error of Estimate 0.0215259643
Sum of Squared Residuals 0.0236317242
Durbin-Watson Statistic 2.140210

Variable	Coeff	Std Error	T-Stat	Signif
1. D_LNINVESTUSA(1)	-0.002974929	0.059240597	-0.05022	0.96014504
2. D_LNRGDPUSA(1)	-0.155967527	0.500650863	-0.31153	0.75666805
3. D_LNLABORPWUSA(1)	0.396566778	0.449088038	0.88305	0.38135336
4. Constant	-0.202660980	0.128652981	-1.57525	0.12138172
5. EC1{1}	-0.005344584	0.002876528	-1.85800	0.06894625

Dependent Variable LNLABORPWUSA
Annual Data From 1952:01 To 2007:01
Usable Observations 56 Degrees of Freedom 51
Mean of Dependent Variable 0.0166031446
Std Error of Dependent Variable 0.0216666220
Standard Error of Estimate 0.0209508664

Sum of Squared Residuals 0.0223858789
Durbin-Watson Statistic 2.218495

Variable	Coeff	Std Error	T-Stat	Signif
1. D_LNINVESTUSA(1)	-0.010127859	0.057657897	-0.17565	0.86126111
2. D_LNRGDPUSA(1)	-0.864230963	0.487275235	-1.77360	0.08210021
3. D_LNLABORPWUSA(1)	1.020883262	0.437089988	2.33564	0.02348082
4. Constant	-0.136241202	0.125215827	-1.08805	0.28168786
5. EC1{1}	-0.003758972	0.002799677	-1.34264	0.18533272

compute sigma=%sigma
errors(model=ectmodel,steps=24)

Decomposition of Variance for Series LNINVESTUSA

Step	Std Error	LNINVESTUSA	LNRGDPUSA	LNLABORPWUSA
1	0.06800652	100.000	0.000	0.000
2	0.08748588	97.111	1.350	1.540
3	0.09512061	90.834	4.604	4.562
4	0.10040413	84.543	8.092	7.365
5	0.10519506	79.818	10.812	9.370
6	0.10999146	76.451	12.772	10.777
7	0.11479527	73.870	14.264	11.866
8	0.11946153	71.692	15.510	12.798
9	0.12393223	69.772	16.602	13.626
10	0.12822323	68.073	17.566	14.360
11	0.13236623	66.579	18.415	15.006
12	0.13638395	65.262	19.163	15.575
13	0.14028910	64.093	19.826	16.081
14	0.14408975	63.048	20.419	16.533
15	0.14779285	62.105	20.953	16.942
16	0.15140518	61.251	21.437	17.312
17	0.15493316	60.474	21.877	17.648
18	0.15838253	59.764	22.280	17.956
19	0.16175838	59.113	22.649	18.238
20	0.16506523	58.513	22.988	18.498
21	0.16830712	57.959	23.302	18.739
22	0.17148774	57.446	23.593	18.961
23	0.17461042	56.969	23.863	19.168
24	0.17767824	56.525	24.115	19.360

Decomposition of Variance for Series LNRGDPUSA

Step	Std Error	LNINVESTUSA	LNRGDPUSA	LNLABORPWUSA
1	0.02054252	78.554	21.446	0.000
2	0.03038450	69.947	29.556	0.497
3	0.03697891	62.093	36.670	1.237
4	0.04222712	56.766	41.423	1.811
5	0.04685592	53.708	44.116	2.175
6	0.05112029	52.035	45.548	2.417
7	0.05508892	51.027	46.370	2.603
8	0.05879087	50.310	46.929	2.761
9	0.06226181	49.744	47.357	2.898
10	0.06554009	49.286	47.698	3.017
11	0.06865771	48.912	47.970	3.118
12	0.07163831	48.606	48.190	3.204

13	0.07449916	48.350	48.371	3.279
14	0.07725366	48.132	48.523	3.345
15	0.07991280	47.944	48.654	3.402
16	0.08248589	47.779	48.768	3.453
17	0.08498087	47.634	48.868	3.498
18	0.08740451	47.505	48.957	3.538
19	0.08976264	47.390	49.036	3.574
20	0.09206033	47.286	49.107	3.607
21	0.09430202	47.192	49.171	3.637
22	0.09649161	47.106	49.230	3.664
23	0.09863259	47.028	49.283	3.689
24	0.10072806	46.956	49.332	3.711

Decomposition of Variance for Series LNLABORPWUSA

Step	Std Error	LNINVESTUSA	LNRGDPUSA	LNLABORPWUSA
1	0.01999369	72.114	22.966	4.919
2	0.02933262	59.499	28.310	12.191
3	0.03593557	49.877	30.757	19.366
4	0.04139108	44.280	30.728	24.992
5	0.04630259	41.472	29.417	29.112
6	0.05089089	40.090	27.720	32.190
7	0.05520133	39.276	26.098	34.626
8	0.05924848	38.671	24.695	36.634
9	0.06305966	38.175	23.511	38.314
10	0.06666796	37.768	22.510	39.722
11	0.07010232	37.438	21.657	40.906
12	0.07338503	37.167	20.925	41.908
13	0.07653327	36.942	20.293	42.765
14	0.07956102	36.751	19.745	43.504
15	0.08248021	36.586	19.266	44.148
16	0.08530116	36.443	18.846	44.712
17	0.08803284	36.317	18.474	45.209
18	0.09068299	36.205	18.143	45.652
19	0.09325835	36.106	17.847	46.047
20	0.09576481	36.017	17.581	46.402
21	0.09820753	35.936	17.341	46.723
22	0.10059109	35.864	17.123	47.013
23	0.10291956	35.797	16.924	47.279
24	0.10519657	35.737	16.742	47.521

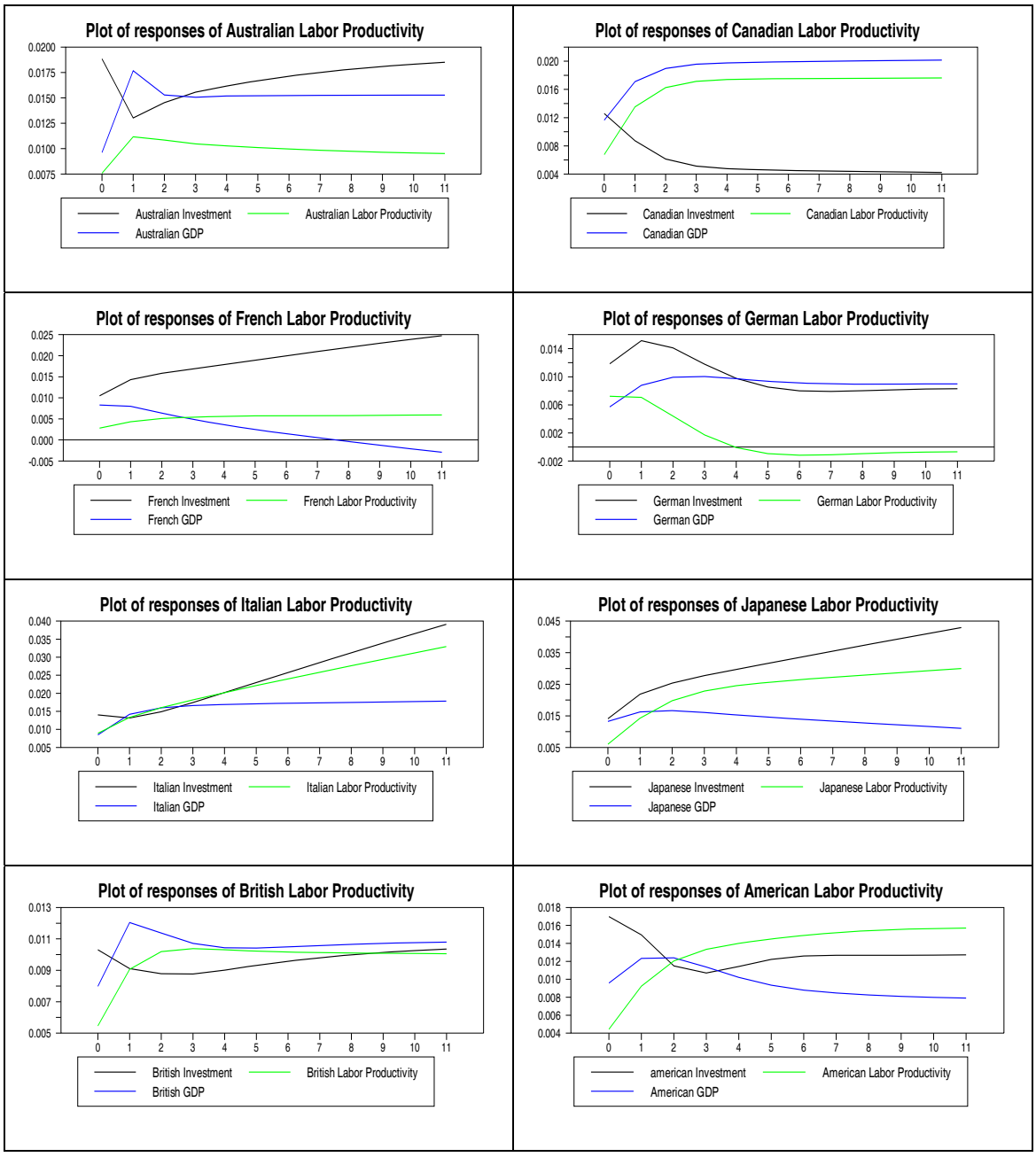
```
compute nsteps = 12

compute [vect[strings]] implabel=|| $
  "american Investment",$
  "American GDP",$
  "American Labor Productivity"||

grparm(nopatterns)
grparm(bold) header 36
grparm axislabeling 27
grparm keylabeling 27

@VARIRF(model=ectmodel,steps=nsteps,vlables=implabel,byshocks,byvariables)
```

Figure A-1. Responses of Labor Productivity in the G7 Countries and Australia Using VECMs



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11.06	Turkington, D.	ON THE DIFFERENTIATION OF THE LOG LIKELIHOOD FUNCTION USING MATRIX CALCULUS
11.07	Groenewold, N. and Paterson, J.E.H.	STOCK PRICES AND EXCHANGE RATES IN AUSTRALIA: ARE COMMODITY PRICES THE MISSING LINK?
11.08	Chen, A. and Groenewold, N.	REDUCING REGIONAL DISPARITIES IN CHINA: IS INVESTMENT ALLOCATION POLICY EFFECTIVE?
11.09	Williams, A., Birch, E. and Hancock , P.	THE IMPACT OF ON-LINE LECTURE RECORDINGS ON STUDENT PERFORMANCE
11.10	Pawley, J. and Weber, E.J.	INVESTMENT AND TECHNICAL PROGRESS IN THE G7 COUNTRIES AND AUSTRALIA