IMPACT MODELING

a) theori

b) Statis nature of the model

c) issue of endogenity and

d) issue of identificatio

Sims (1980): Vector Auto Regression model.

Reasons for Impact Analysis

1. Structural Relationship (mainly concerned with sign, magnitude, significance of structural parameters)
2. Forecasting Future path of the economy (Forecast ~~or~~ forecast evaluation)
3. Policy Analysis (Policy scenarios) — Play with policy scenarios

How VAR model is different from Regression equation

1. VAR is atheoritic (no economic theory needed)
2. It considers all variables in the system as endogenous variables and their lags as explanatory variables
3. The model studies Dynamic interaction that exist b/w macro-economic variables

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$w_t = (Y_t, X_t, Z_t)$

1. Integration
2. Co-integration

If $w_t \sim I(0) \rightarrow$ LEVEL VAR

$w_t \sim I(1)$
and no
co-integration $\rightarrow$ DIFFERENCED VAR

$w_t \sim I(1)$ and C.I $\rightarrow$ VECM.

C.I.-VAR

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Reduced Form VAR

Reduced form
Recursive VAR

under both level VAR
and Differenced VAR
we can two models
(a) Reduced Form VAR
(b) Recursive VAR

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SIMS (1980) – VAR MODEL.

$w_t = (x_t, y_t, z_t)$ – all these are observed

$w_t = (y_{1t}, y_{2t}, \ldots, y_{n_t})$

observed

If the DGP of w_t

$$\overset{\text{VECTOR}}{w_t} = \overset{\text{VECTOR}}{\mu_t} + \overset{\text{VECTOR}}{x_t} \quad \text{—— (4)}$$

μ_t: Deterministic component; x_t: stochastic.

$$\mu_t = \mu_0 + \mu_1 t \quad \text{—— (1)}$$

If $\mu_1 = 0$ then $\mu_t = \mu_0$ (then there is no role of trend)

when write X in form of VAR (p)

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$$X_t = A_1 X_{t-1} + A_2 X_{t-2} + \ldots + A_p X_{t-p} + e_t$$

$$X_t - A_1 X_{t-1} - A_2 X_{t-2} - \ldots - A_p X_{t-p} = e_t$$

Identity matrix

$$\left[I_k - A_1(L) - A_2(L^2) - \ldots - A_p(L^p)\right] x_t = e_t$$

<u>NOTATION OF LAG</u>

$$y_t = \alpha_1 y_{t-1} + \alpha_2 y_{t-2}$$

$$= \alpha_1 (L^1) + \alpha_2 (L^2) + \alpha_3 (L^3) + \ldots \alpha_p [L^p]$$

$I(k) - A_1 L - A_2(L^2) - \dots$

$$\dots A_p(L^p) = A(L)$$

$$A(L) X_t = e_t \quad \text{———} \quad (2)$$

$$A(L)(w_t) = A(L) u_t$$
$$+ A(L) X_t$$

This is multiply $A(L)$ on both sides of 1

$$A(L) w_t = A(L) u_t + e_t$$

w_t has taken over the dynamics

$$e_t = A(L) X_t$$

$$[I_k - A_1(L) - A_2(L^2) - \dots$$
$$\dots A_p(L^p)] \cdot w_t = A(L) u_t + e_t$$

$$w_t - A_1 w_{t-1} - A_2 w_{t-2} + \dots$$

$$\dots A_p w_{t-p} = A(L) u_t + e_t$$

$$w_t = A_1 w_{t-1} + A_2 w_{t-2} + \dots$$

$u_t = u_0 + u_1 t$

$$\dots + A_p w_{t-p} + \underbrace{A(L) u_t}_{\text{This portion is left}} + e_t$$

$A(L)[\mu_0 + \mu_1 t]$

$= A(L)\mu_0 + A(L)\mu_1 t$

$$V_0 = \left[I_k - \sum_{j=1} A_j\right] u_0 + \left(\sum_j A_j\right) u_0$$

V_0 represented by $A(L)\mu_0$ and $A(L)\mu_1 t$ is represented by V_1

$A(L)\mu_1$

$$\mu_1 = \left[I_k - \sum_{j=1} A_j \right] u_1$$

$A(L)\, x_t$

$$w_t = v_0 + v_1 + A_1 w_{t-1} + A_2 w_{t-2} + \cdots + A_p w_{t-p} + e_t \quad \text{—— (4)}$$

Reduced form of VAR

$$A(L)\, w_t = A(L)\, u_t + A(L)\, x_t$$

This corresponds to the DGP of the model at the start

The w_t EQUA. CAN BE EXPRESSED

$$\begin{pmatrix} x_t \\ y_t \\ z_t \end{pmatrix} = \begin{pmatrix} v_{01} \\ v_{02} \\ v_{03} \end{pmatrix} + v_1 \cdot t + \begin{pmatrix} A_{11} & A_{12} & A_{13} \\ A_{21} & A_{22} & A_{23} \\ A_{31} & A_{32} & A_{33} \end{pmatrix} \begin{pmatrix} x_{t-1} \\ y_{t-1} \\ z_{t-1} \end{pmatrix} + \cdots$$

$$
\cdots + \begin{pmatrix} A_{11} & A_{12} & A_{1p} \\ A_{21} & A_{22} & A_{2p} \\ A_{m1} & A_{m2} & A_{mp} \end{pmatrix} \begin{pmatrix} X_{t-p} \\ y_{t-p} \\ z_{t-p} \end{pmatrix} + \begin{pmatrix} e_{t1} \\ e_{t2} \\ z_{t3} \end{pmatrix}
$$

EXPANSION (LEVEL REDUCED VAR)

$$
X_t = V_{01} + V_{1t} + A_{11} X_{t-1} + A_{12} y_{t-1} + A_{13} z_{t-1} + \cdots + A_{11} X_{t-p} + A_{12} y_{t-p} + A_{1p} z_{t-p} + e_1
$$

$$
y_t = V_{01} + V_{1t} + A_{21} X_{t-1} + A_{22} y_{t-1} + A_{23} z_{t-2} + \cdots + A_{21} X_{t-p} + A_{22} y_{t-p} + A_{2p} z_{t-p} + e_{t2}
$$

$$
z_t = V_{03} + V_{1t} + A_{31} X_{t-1} + A_{32} y_{t-1} + A_{33} z_{t-1} + \cdots + A_{31} X_{t-p} + A_{32} y_{t-p} + A_{3p} z_{t-p} + e_{t3}
$$

RECURSIVE VAR

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$$A(L)\, w_t = v_0 + v_1 t + e_t$$

x_t eq.

$$A(L)\, \cancel{y_t}\, w_t = v_{01} + v_{1t} + e_{1t}$$

y_t eq.

$$A(L)\, w_t = v_{02} + v_{1t} + y_t + e_{2t}$$

z_t eq.

$$A(L)\, w_t = v_{03} + v_{1t} + y_t + x_t + e_{3t}$$

Recursive LEVEL VAR

we run this model only if $w_t \sim I(0)$

$x_t \sim I(0)$

$y_t \sim I(0)$

$z_t \sim I(0)$

$$A(L) = I_k - A_1(L) - A_2(L^2) - \ldots - A_p(L^p)$$

$$= \cancel{I_k - A_1} - A_1(L) - A_2(L^2) - \ldots - A_p(L^p)$$

(This is redefined so that we donot come up w_t I_k remodelled for consistency

Ex.

$$y_t = \alpha_1 y_{t-1} + \alpha_2 y_{t-2} + \dots \alpha_p y_{t-p} \text{ — } AR(p)$$

$$y_t - \alpha_1 y_{t-1} - \alpha_2 y_{t-2} + \dots \alpha_p y_{t-p} = e_t$$

$$\left[I_k - \alpha(L) - \alpha_2 (L^2) \dots \alpha_p (L^p) \right] = \alpha(L)$$

so, the whole model

$$\alpha(L^p) \overset{\text{vector}}{y_t} = e_t \text{ — } AR(p)$$