# Methodology summary

A reduced-form VAR model (Sims, 1981) is

where is a *K*-dimensional vector of endogenous variables; *Ap* is a *K-by-K* matrix.

The VAR(*p*) can be casted in the companion VAR(1) form as follows

where

, ,

If we assume the VAR(*p*) process is stable, then its moving average (MA) representation can be obtained by successive substitution for . Thus, it can be read

where is the selection matrix; for , so that these matrices is recursively computed as

, and for , with for .

The matrix is also called the response of variable *k* to a unit shock , , *i* periods ago.

Let us define the forecast error at the *hth* horizon . If one decomposes with then defines such that , and .[[1]](#footnote-1)

Thus, the forecast error variance of at horizon *h* is

Dividing by to give the fraction of the contribution of shock *j* to the forecast error variance of variable *k*.

Diebold and Yilmaz, hereafter DY, (2009) define the Spillover Index to measure the spillover effects (or connectedness) across firms, markets or countries.

**Diebold – Yilmaz Connectedness Table (FEVD)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Country 1 | Country 2 |  |  | Country N | FROM Others |
| Country 1 |  |  |  |  |  |  |
| Country 2 |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
| Country N |  |  |  |  |  |  |
| TO Other |  |  |  |  |  |  |

Note: .

According to Diebold and Yilmaz (2014), total directional connectedness *from others* tocountry *ith* is defined as

and total directional connectedness *to* *others* from country *jth*­ as

Therefore, we defined net total directional connectedness measures as , and pairwise directional connectedness between country *ith* andcountry *jth* is simply . For example, is the pairwise directional connectedness between country 1 and country 2.

The main difference between DY (2009) and DY (2012) is how factor matrix *P* defined. In the former, Cholesky decomposition gives orthogonalized shocks so that the variable ordering will be matter. Meanwhile, the generalized VAR framework due to Koop, Pesaran, and Potter (1996) and Pesaran and Shin (1998) is utilized in the latter (DY, 2012).

In the generalized VAR approach, the FEVD is computed at horizon *h = H* as follows

where is column *kth* of the matrix. However, generalized FEVD does not guarantee the row sum or column sum of one, therefore, DY (2012) suggest the normalization as

such that and .

1. See Lutkepohl (2005), and Kilian and Lutkepohl (2017). [↑](#footnote-ref-1)