Nepal Input Output Tables

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Linkages

Backward linkages:

backward linkage is a measure of the reliance of an industry on *upstream* industries for its intermediate inputs.

Calculating backward linkages:

Direct backward linkage of a sector j is given by the sum of elements in the *jth* column of the technical coefficients matrix A.

$$\sum_{i=1}^{n} a_{ij} = \begin{bmatrix} a_{11} & .. & a_{1n} \\ .. & .. & .. \\ a_{n1} & .. & a_{nn} \end{bmatrix}$$

Here, $a_{ij} = z_{ij}/x_j$ where z_{ij} is the intermediate sales from sector i to sector j and x_j is the *gross output* of sector j.

Measuring direct backward linkage

Since $\mathbf{x} = C\mathbf{x} + \mathbf{d}$, we can rewrite the matrix equation as

$x_1 = c_{11}x_1 + c_{12}x_2 + ... + c_{1j}x_j + ... + c_{1n}x_n + d_1$
$x_2 = c_{21}x_1 + c_{22}x_2 + ... + c_{2j}x_j + ... + c_{2n}x_n + d_2$
.
.
.
$x_n = c_{n1}x_1 + c_{n2}x_2 + ... + c_{nj}x_j + ... + c_{nn}x_n + d_n$

So, for any industry j, the direct backward linkage is the sum of the elements of column j in the associated technical coefficients matrix C.

Normalized backward linkages

Normalized direct backward linkage is obtained by dividing sector j's direct backward linkages by the mean of all direct backward linkages. **Normalized total backward linkage** is obtained by dividing sector j's total backward linkages by the mean of all total backward linkages.

Forward linkages

Forward linkage is a measure of the reliance of *downstream* industries for a particular industries outputs (which are intermediate inputs for those industries).

As in the case of forward linkages, we can calculate both direct and total forward linkages. **Direct forward linkage** of sector i is given by the *row sums of the output coefficients matrix* B for that sector.

$$\sum_{i=1}^{n} l_{ij} = \begin{bmatrix} l_{11} & .. & l_{1n} \\ .. & .. & .. \\ l_{n1} & .. & l_{nn} \end{bmatrix}$$

Given $\mathbf{x} = L\mathbf{f}$, we can rewrite the matrix equation as

$x_1 = l_{11}f_1 + l_{12}f_2 + ... + l_{1j}f_j + ... + l_{1n}f_n$
$x_2 = l_{21}f_1 + l_{22}f_2 + ... + l_{2j}f_j + ... + l_{2n}f_n$
.
.
.
$x_n = l_{n1}f_1 + l_{n2}f_2 + ... + l_{nj}f_j + ... + l_{nn}f_n$

Total forward linkage captures both direct and indirect effects and is given by the *row sums of the output inverse matrix* $G = (I - B)^{-1}$ where I is the $35X35$ identity matrix and B is the output coefficients matrix.

Normalized direct forward linkage is obtained by dividing sector i's direct forward linkages by the mean of all direct forward linkages. **Normalized total forward linkage** is obtained by dividing sector i's total forward linkages by the mean of all total forward linkages.

```
# A tibble: 35 x 3
   industry                                                value normalized_value
   <chr>                                                   <dbl>            <dbl>
 1 Agriculture, hunting, forestry, and fishing                 1              NaN
 2 Mining and quarrying                                        1              NaN
 3 Food, beverages, and tobacco                                1              NaN
 4 Textiles and textile products                               1              NaN
 5 Leather, leather products, and footwear                     1              NaN
 6 Wood and products of wood and cork                          1              NaN
 7 Pulp, paper, paper products, printing, and publishing       1              NaN
 8 Coke, refined petroleum, and nuclear fuel                   1              NaN
 9 Chemicals and chemical products                             1              NaN
10 Rubber and plastics                                         1              NaN
# i 25 more rows
```