

## TiVA 2016 indicators - definitions

### How to read this document and interpret the indicator values

- The indicators are calculated for  $N = 64$  economies<sup>1</sup> and  $K = 34$  industries<sup>2</sup>.
- The years covered are 1995 to 2011.
- The indicators are expressed in USD million (in current prices) or as percentages.
- The TiVA indicators are printed in blue in the equations to clearly show the relation between the indicators. The variables representing the ICIO system are printed in black.

### Tables from OECD's Inter-Country Input-Output (ICIO) system

The OECD's ICIO system consists of a set of symmetric industry by industry global input-output tables. For each year, several matrices can be generated from the ICIO to calculate TiVA indicators:

Matrix	Size of the matrix	Description
<b>VALU</b>	$1 \times (N * K)$	Value added by industry and country
<b>PROD</b>	$1 \times (N * K)$	Gross output by industry and country
<b>V</b>	$1 \times (N * K)$	Value added to output ratio $V_j = VALU_j / PROD_j$ by industry and country
<b>A</b>	$(N * K) \times (N * K)$	Input coefficients, calculated as $A_{ij} = Z_{ij} / PROD_j$
<b>B</b>	$(N * K) \times (N * K)$	Global Leontief inverse $\mathbf{B} = (\mathbf{I} - \mathbf{A})^{-1}$
<b>FD</b>	$(N * K) \times N$	Global final demand matrix showing the demand of country p (in column) for goods and services from industry i in country c (rows)
<b>GRTR_INT</b> <b>GRTR_FNL</b>	$(N * K) \times N$	Global bilateral gross trade matrices by exporting industry/country and importing country for intermediate (INT) or final (FNL) goods

### Further notes on notation:

$EXGR_{c,p}$  represents a  $K \times 1$  vector of gross exports from country c to country p for all K industries, where  $c \neq p$ .  $EXGR_c$  is a  $K \times 1$  vector of total exports of country c.

$V_c = [v_{c1} \dots v_{cK}]$  is a  $1 \times K$  row vector with domestic value added shares of output for each industry i, while  $V_p$  generally represents value added shares of the partner country.  $\hat{V}_c$  denotes the diagonalized matrix of vector  $V_c$ , i.e. a  $K \times K$  matrix with elements  $v_{c1} \dots v_{cK}$  on the diagonal and 0 elsewhere.

$\mathbf{B} = (\mathbf{I} - \mathbf{A})^{-1}$ , is the global Leontief inverse matrix with  $NK \times NK$  dimensions, where A is the global I-O coefficient matrix.  $B_{c,c}$  is a  $K \times K$  diagonal block matrix of B representing total domestic gross output required for one unit increase of country c's demand.  $B_{p,c}$  is also a  $K \times K$  block matrix, and it represents the total gross output from country p required for a one unit increase in country c's demand.

1. Note that indicators are provided for regional aggregates. Once USD million measures have been calculated for the 64 economies, aggregation to various regional groupings is carried out before ratios and shares are derived.

2. Note that indicators are provided for aggregate sectors. Once USD million measures have been calculated for the 34 unique industries, summing to aggregate industry sectors is carried before ratios and shares are derived.

For each indicator it is presented a specification of its dimension, where the abbreviations are as follow:

*Country / Region:*

Prod cou = Production country  
VA src cou = VA source country  
Exp cou = Export country  
Imp cou = Import country  
Dem cou = final demand / destination country  
World = all countries includes domestic economy  
Foreign = all countries excludes domestic economy  
NA = no partner. Result only appears in partner "World"

*Industry:*

VA src ind = VA source industry, production source industry  
Exp ind = Export products producing industry  
Imp ind = Import products producing industry  
Dem ind = final demand products producing industry

*Supply and Demand Dimensions:*

Depending on the indicator, the supply and demand dimensions could refer to intermediate, final or total goods.

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**BASIC MEASURES FROM THE OECD INTER-COUNTRY INPUT-OUTPUT (ICIO) DATABASE**
**Notes:**

Total gross exports and imports in the ICIO, and hence TiVA, differ from official National Accounts statistics due to removal of estimates of re-exports and re-imports, conversion to a Basic Price valuation and reconciliation of bilateral asymmetries via balancing under output constraints.

Discrepancies, which are residuals from inconsistencies in global trade data, were allocated to the total final demand of the Rest of World.

Changes in inventories for a given country are allocated to the respective country total final demand.

The USD million gross trade and output measures are in current prices with a basic price valuation .

**Gross exports, by industry and by partner country**, USD million (f.o.b.)

Dimension of the next 3 indicators: [Exp cou | Exp ind | Imp cou]

Country  $c$ 's total gross exports for a given industry  $i$  can be directly calculated from the ICIO system by summing up exports in intermediate goods and services and exports of final demand goods and services.

$$EXGR_{c,i} = \sum_p EXGR_{c,p,i} = \sum_p (EXGR\_INT_{c,p,i} + EXGR\_FNL_{c,p,i})$$

where  $EXGR\_INT_{c,p,i}$  represents gross exports of intermediate goods and services from domestic industry  $i$  in country  $c$  to country  $p$ , and  $EXGR\_FNL_{c,p,i}$  is gross exports of final demand goods and services, where  $c$  and  $p \in [1, \dots, N]$  and  $c \neq p$ . They can be calculated from the gross trade matrices as:

$$EXGR\_INT_{c,p,i} = GRTR\_INT_{(c-1)*N+i,p}$$

$$EXGR\_FNL_{c,p,i} = GRTR\_FNL_{(c-1)*N+i,p}$$

**Gross imports, by industry and by partner country**, USD million (f.o.b.)

Dimension of the next 3 indicators: [Imp cou | Exp ind | Exp cou]

Total imports of country  $c$  are measured as:

$$IMGR_{c,i} = \sum_p IMGR_{c,p,i} = \sum_p (IMGR\_INT_{c,p,i} + IMGR\_FNL_{c,p,i})$$

where  $IMGR\_INT_{c,p,i}$  is gross imports of intermediates by country  $c$  from industry  $i$  in country  $p$ ; and  $IMGR\_FNL_{c,p,i}$  is gross imports of final demand goods and services.

They can be calculated from the gross trade matrices as:

$$IMGR\_INT_{c,p,i} = GRTR\_INT_{(p-1)*N+i,c}$$

$$IMGR\_FNL_{c,p,i} = GRTR\_FNL_{(p-1)*N+i,c}$$

**Gross exports, partner shares %, by industry**, percentage

*Dimension: [Exp cou | Exp ind | Imp cou]*

The partner shares are calculated for each country, industry and partner country by dividing by total exports of the industry and country. The industry is the exporting industry.

$$EXGRpSH_{c,p,i} = \frac{EXGR_{c,p,i}}{\sum_p EXGR_{c,p,i}} \times 100$$

**Gross imports, partner shares %, by industry**, percentage

*Dimension: [Imp cou | Exp ind | Exp cou]*

The partner shares are calculated for each country, industry and partner country by dividing by total imports of the industry and country. The industry refers to the exporting industry (i.e. from country *c*'s perspective, the industry of origin of the imports).

$$IMGRpSH_{c,p,i} = \frac{IMGR_{c,p,i}}{\sum_p IMGR_{c,p,i}} \times 100$$

**Gross trade balance, by partner country**, USD million (f.o.b.)

*Dimension: [Export cou | Trade product | Imp cou]*

The gross trade balance is given for each country and partner combination.

$$BALGR_{c,p} = EXGR_{c,p} - IMGR_{c,p}$$

**Value added as a share of Gross Output, by industry**, percentage

*Dimension: [Prod cou | VA src ind | NA]*

The value added share is given for each industry in each country.

$$PROD\_VASH_{c,i} = \frac{VALU_{c,i}}{PROD_{c,i}}$$

## VALUE ADDED CONTENT OF GROSS EXPORTS AND IMPORTS

The USD million gross trade measures are in current prices with a basic price valuation

**Domestic value added embodied in gross exports, by industry and by partner country**, USD million

*Dimension: [VA src cou | VA src ind | Dem cou]*

Domestic value added content of gross exports includes the value added generated by the exporting industry during its production processes as well as any value added coming from upstream domestic suppliers that is embodied in the exports.

$$EXGR\_DVA_{c,p,i} = V_c B_{c,c} EXGR_{c,p,i}$$

Where  $EXGR_{c,p,i}$  is a  $K \times 1$  vector with all entries equal to zero except the one corresponding to industry  $i$ .

**Foreign value added content of gross exports, by industry**, USD million

*Dimension: [VA src cou | Exp ind | Foreign]*

Foreign value added content of gross exports captures the value of imported intermediate goods and services that are embodied in a domestic industry's exports. The value added can come from any foreign industry upstream in the production chain.

$$EXGR\_FVA_c = V_c B_{(c),c} EXGR_{c,i}$$

With  $B_{(c),c}$  being the column block of  $B$  corresponding to country  $c$ , with the row block corresponding to  $c$  being zero.

**Domestic value added share of gross exports**, percentage

*Dimension: [VA src cou | VA src ind | Foreign]*

The share of domestic value added in gross exports is available by industry for partner world.

$$EXGR\_DVASH_{c,i} = \frac{\sum_p EXGR\_DVA_{c,p,i}}{\sum_p EXGR_{c,p,i}} \times 100$$

**Foreign value added share of gross exports**, percentage

*Dimension: [VA src cou | Exp ind | Foreign]*

The share of foreign value added in gross exports is available by industry for partner world.

$$EXGR\_FVASH_{c,i} = \frac{\sum_p EXGR\_FVA_{c,p,i}}{\sum_p EXGR_{c,p,i}} \times 100$$

**Domestic value added embodied in foreign exports as share of gross exports, percentage**

*Dimension: [VA src cou | Exp ind | Foreign]*

This indicator presents the ratio between the domestic value added content of gross exports of foreign countries industry  $i$  to gross exports of source country  $c$ .

$$EXGR\_DVAFXSH_{c,i} = \frac{\sum_p EXGR\_BSCI_{c,i,t,p,i}}{\sum_p EXGR_{c,p}} \times 100$$

**Industry domestic value added contribution to gross exports, as a percentage of total gross exports**

*Dimension: [VA src cou | VA src ind | Foreign]*

This indicator reflects the share, in total gross exports, of domestic value added in an industry's exports. The sum over all industries is the total domestic value added share of gross exports (EXGR\_DVASH)

$$EXGR\_TDVAIND_{c,i} = \frac{\sum_p EXGR\_DVA_{c,p,i}}{\sum_{p,i} EXGR_{c,p,i}} \times 100$$

**Industry foreign value added contribution to gross exports, as a percentage of total gross exports**

*Dimension: [VA src cou | VA src ind | Foreign]*

This indicator reflects the share, in total gross exports, of foreign value added in an industry's exports. The sum over all industries is the total foreign value added share of gross exports (EXGR\_FVASH)

$$EXGR\_TFVAIND_{c,i} = \frac{\sum_p EXGR\_FVA_{c,p,i}}{\sum_{p,i} EXGR_{c,p,i}} \times 100$$

**Domestic value added in exports of final products as a share of total gross exports, percentage**

*Dimension: [VA src cou | VA src ind | Foreign]*

This indicator shows the share of domestic value added in exports of final goods and services as a share of total gross exports. The indicator is available by country and industry.

$$EXGR\_FNLDVASH_{c,i} = \frac{\sum_p EXGR\_FNLDVA_{c,p,i}}{\sum_p EXGR_{c,p,i}} \times 100$$

**Domestic value added in exports of intermediate products as a share of total gross exports, percentage**

*Dimension: [VA src cou | VA src ind | Foreign]*

This indicator shows the share of domestic value added in exports of intermediate goods and services as a share of total gross exports. The indicator is available by country and industry.

$$EXGR\_INTDVASH_{c,i} = \frac{\sum_p EXGR\_INTDVA_{c,p,i}}{\sum_p EXGR_{c,p,i}} \times 100$$

**Domestic value added in gross exports, partner shares, percentage**

*Dimension: [VA src cou | VA src ind | Dem cou]*

For each country and industry, this indicator shows the importing partner distribution of domestic value added in gross exports.

$$EXGR\_DVApSH_{c,p,i} = \frac{EXGR\_DVA_{c,p,i}}{\sum_p EXGR\_DVA_{c,p,i}} \times 100$$

**Domestic value added in exports of intermediate products, partner shares, percentage**

*Dimension: [VA src cou | VA src ind | Dem cou]*

For each country and industry, this indicator shows the importing partner distribution of domestic value added in gross exports of intermediate goods and services.

$$EXGR\_INTDVApSH_{c,p,i} = \frac{EXGR\_INTDVA_{c,p,i}}{\sum_p EXGR\_INTDVA_{c,p,i}} \times 100$$

**Domestic value added embodied in gross imports, by exporting industry and exporting country,**  
USD million

*Dimension: [Imp cou | Exp ind | Exp cou]*

Domestic value added content of gross imports includes the total domestic value added embodied in the imports made by the importing country  $c$  from the exporting industry  $i$  of exporting country  $p$ .

$$\text{IMGR\_DVA}_{c,i,p} = \sum_l V_{c,l} B_{c,l,p,i} \text{IMGR}_{p,i,c}$$

Where  $\text{IMGR}_{p,i,c}$  is a  $K \times K$  diagonal matrix with the imports of country  $c$  from the exporting industries of partner country  $p$ .

**Domestic value added share of gross imports, percentage**

*Dimension: [Imp cou | Exp ind | Exp cou]*

Domestic value added share of gross imports (IMGR\_DVASH) is defined as the domestic value added embodied in gross imports (IMGR\_DVA) by exporting industry *i* of exporting country *p* divided by total gross imports of exporting industry *i* of exporting country *p*, in %. It is a 'DVA intensity measure' and reflects how much domestic value-added is embodied per unit of total gross imports from exporting industry *i* of exporting country *p*.

$$IMGR\_DVASH_{c,i,p} = \frac{IMGR\_DVA_{c,i,p}}{\sum_p IMGR_{c,i,p}} \times 100$$

### DECOMPOSITION OF DOMESTIC VALUE ADDED (DVA) IN GROSS EXPORTS - 3 DOMESTIC ORIGINS.

Domestic value added content of gross exports can be split further into three components, direct domestic industry value added, indirect domestic value added and re-imports.

**Direct domestic industry value added content of gross exports, USD million**

*Dimension: [VA src cou | VA src ind | Foreign]*

$$EXGR\_DDC_c = \hat{V}_c \text{diag} B_c EXGR_c$$

**Indirect domestic content of gross exports (originating from domestic intermediates), USD million**

*Dimension: [VA src cou | VA src ind | Foreign]*

$$EXGR\_IDC_c = \hat{V}_c \text{offdiag} B_c EXGR_c - EXGR\_DDC_c$$

**Re-imported domestic value added content of gross exports, USD million**

*Dimension: [VA src cou | VA src ind | Foreign]*

$$EXGR\_RIM_c = \hat{V}_c B_{c,c} EXGR_c - EXGR\_DDC_c - EXGR\_IDC_c$$

where  $EXGR\_DDC_c$ ,  $EXGR\_IDC_c$ , and  $EXGR\_RIM_c$  are  $K \times 1$  vectors representing the industry dimension and  $A_c$  is a local I-O coefficient matrix from country  $c$ 's single Input-Output table and  $B_c = (I - A_c)^{-1}$  is the local Leontief inverse. Matrix  $\text{diag} B_c$  consists of the diagonal elements of the local Leontief inverse, i.e. those entries of the matrix displaying the direct requirements, while matrix  $\text{offdiag} B_c$  is the local Leontief inverse with all diagonal elements set to zero, thus representing the indirect requirements.

$EXGR\_DDC_{c,i}$  is the  $i$ -th element of the  $K \times 1$  vector  $EXGR\_DDC_c$ , and gives direct domestic value added context of gross export of a given industry  $i$ . Same rule applies to indirect domestic value added and re-import shares of gross exports. Foreign value added share of gross exports is summed for all partners.

**FINAL DEMAND MEASURES (ORIGINS OF VALUE ADDED)**

*Discrepancies and changes in inventories are only considered in the world total, not at partner level.*

**Domestic value added embodied in foreign final demand, USD million**

*Dimension: [VA src cou | VA src ind | Dem cou]*

$$FFD\_DVA_{c,p} = (\hat{\mathbf{V}} \mathbf{B} \mathbf{FD})_{c,p}$$

$FFD\_DVA_{c,p}$  is a  $K \times 1$  vector. Matrix  $\hat{\mathbf{V}} \mathbf{B} \mathbf{FD}$  is of size  $(KN \times K)$  and calculated from multiplying the three global matrices  $\hat{\mathbf{V}}$ , the diagonalized value added share of production  $PROD\_VASH$ ,  $\mathbf{B}$  the global Leontief inverse and  $\mathbf{FD}$  the global final demand matrix showing the demand of country  $p$  (in column) for goods and services from industry  $i$  in country  $c$  (rows), and  $(\hat{\mathbf{V}} \mathbf{B} \mathbf{FD})_{c,p}$  is the part of the matrix with  $K$  rows (one for each industry) corresponding to country  $c$  and column corresponding to country  $p$ . This is only available for  $p \neq c$ .  $FFD\_DVA$  is available by value added country, value added industry, and partner country.

$FFD\_DVA_{c,p,i}$  is the  $i$ -th element of the  $K \times 1$  vector  $FFD\_DVA_{c,p}$

**Domestic value added embodied in foreign final demand, partner shares, percentage**

*Dimension: [VA src cou | VA src ind | Dem cou]*

$$FFD\_DVApSH_{c,p,i} = \frac{FFD\_DVA_{c,p,i}}{\sum_p FFD\_DVA_{c,p,i}} \times 100$$

$FFD\_DVApSH$  is available by country and industry origin of value added and final demand partner country.

**Domestic value added embodied in foreign final demand as a % of total value added, percentage**

*Dimension: [VA src cou | VA src ind | NA]*

$$VALUX\_FFDDVA_{c,i} = \frac{\sum_p FFD\_DVA_{c,p,i}}{VALUX_{c,i}} \times 100$$

Where  $VALUX$  is value added adjusted to be consistent with final demand (both domestic and foreign) which excludes "changes in inventories" (which captures goods produced in previous periods and, possibly, of non-domestic origin). This is available by country and industry origin of value added.

**Foreign value added embodied in domestic final demand, USD million**

*Dimension: [Dem cou | VA src ind | VA src cou]*

$$DFD\_FVA_{c,p} = (\hat{V} B FD)_{p,c}$$

$DFD\_FVA_{c,p}$  is the part of matrix  $\hat{V} B FD$  with rows corresponding to country  $p$ 's industries and column  $c$  of domestic consumption. This is only available for  $p \neq c$ .  $DFD\_FVA_{pSH}$  is available by country, partner country (where the value is added) and value added industry in the partner country.

$DFD\_FVA_{c,p,i}$  is the  $i$ -th element of the  $K \times 1$  vector  $DFD\_FVA_{c,p}$

**Foreign value added embodied in domestic final demand, partner shares, percentage**

*Dimension: [Dem cou | VA src ind | VA src cou]*

$$DFD\_FVA_{pSH}_{c,p,i} = \frac{DFD\_FVA_{c,p,i}}{\sum_p DFD\_FVA_{c,p,i}} \times 100$$

$DFD\_FVA_{pSH}$  is available by country and, partner country and industry origin of value added.

**Value added embodied in final demand, balance, USD million**

*Dimension: [VA src cou | VA src ind | Dem cou]*

The balance is calculated as the difference between domestic value added embodied in foreign final demand and foreign value added in domestic final demand by value added origin industry.

$$BALVAFD_{c,p,i} = FFD\_DVA_{c,p,i} - DFD\_FVA_{c,p,i}$$

**Value added embodied in final demand, consumption and GFCF , USD million**

*Dimension of these 3 indicators: [VA src cou | VA src ind | Dem cou]*

Similarly, value added (in industry  $i$  of country  $p$ ) in final demand  $FD$ , consumption ( $CONS$ ) and gross fixed capital formation ( $GFCF$ ) of country  $c$  are defined as the  $K \times 1$  vectors (representing the  $K$  industries)

$$FD\_VA_{c,p} = (\hat{V} B FD)_{p,c}$$

$$CONS\_VA_{c,p} = (\hat{V} B CONS)_{p,c}$$

$$GFCF\_VA_{c,p} = (\hat{V} B GFCF)_{p,c}$$

Here, the indicator includes domestic value added embodied in domestic demand, *i.e.*  $p = c$  is possible.

**Value added shares in final demand, consumption and GFCF , by source country and industry, percentage**

*Dimension of these 3 indicators: [Dem cou | VA src ind | VA src cou]*

These indicators look on the demand side of the countries, i.e., for the total domestic demand (final demand, consumption or GFCF) of a country  $c$  they show what is the share of the value added from source country  $p$ 's industry  $i$  in country  $c$ 's total value added consumed and which has its origin in industry  $i$ . They are defined as follow:

$$FD\_VASH_{c,p,i} = \frac{FD\_VA_{c,p,i}}{\sum_p FD\_VA_{c,p,i}} \times 100$$

$$CONS\_VASH_{c,p,i} = \frac{CONS\_VA_{c,p,i}}{\sum_p CONS\_VA_{c,p,i}} \times 100$$

$$GFCF\_VASH_{c,p,i} = \frac{GFCF\_VA_{c,p,i}}{\sum_p GFCF\_VA_{c,p,i}} \times 100$$

### RE-EXPORTED INTERMEDIATE IMPORTS

#### Re-exported intermediate imports, USD million

*Dimension: [Exp cou | Prod ind | World]*

Imported products which are used as inputs into production processes and then exported again are referred to as re-exported intermediate products. This indicator is available by country and exporting industry.

$$REII_{c,i} = \left( \sum_p A_{p,c} B_{c,c} EXGR_c \right)_i$$

$A_{p,c}$  is a  $K \times K$  off-diagonal block matrix of  $A$  giving  $c$ 's imported intermediate products sourced from country  $p$  required to produce one unit of output.

$EXGR_c$  is  $K \times 1$  vector, represent exports of each industry  $i$  of country  $c$  to all other countries.  $A_{p,c} B_{c,c} EXGR_c$ , is also a  $K \times 1$  vector and refers to intermediate goods and services absorbed in country  $c$  that originated from  $p$  for total exports by  $c$ .

$\left( \sum_p A_{p,c} B_{c,c} EXGR_c \right)_i$  refers to the  $i$ -th element of the vector, gives total intermediate goods and services absorbed by country  $c$  that originated from all foreign countries in industry  $i$ .

#### Re-exported intermediate imports as a % of total intermediate imports, percentage

*Dimension: [Exp cou | Prod ind | World]*

Re-exported intermediate imports by exporting industry as a share of intermediate imports shows how much of the imports are exported.

$$IMGRINT\_REII_{c,i} = \left( \sum_p A_{p,c} B_{c,c} EXGR_c \right)_i / \sum_p IMGR\_INT_{c,p,i}$$

$\sum_p IMGR\_INT_{c,p,i}$  is total intermediate imports of country  $c$  from each industry  $i$ .

**SERVICE VALUE ADDED CONTENT**

The indicators dealing with service value added content consider only the service industries as a source of value added; export or final demand industries are all industries. If the value of the indicator is greater than zero then the industry's exports include value added content generated in the service industries (ISIC Rev 3, 45 to 95).

$\widehat{V}_{c,j}$  is the diagonal matrix  $\widehat{V}_c$ , with all entries corresponding to industry  $i \neq j$  equal to zero and the element corresponding to  $j \in S$  to the value added share of service industry  $j$  in country  $c$ .  $S$  is the set of service industry indices.  $(B_{c,c})_{ji}$  and  $(B_{p,c})_{ji}$  are the  $ji$ -th element of  $B_{c,c}$  and  $B_{p,c}$  respectively.

**Domestic services value added share in gross exports, percentage**

*Dimension: [VA src cou | VA src ind | Foreign]*

$$\text{EXGR\_SERV\_DVASH}_{c,i} = \frac{\text{EXGR\_SERV\_DVA}_{c,i}}{\text{EXGR}_{c,i}} \times 100$$

where:

$$\text{EXGR\_SERV\_DVA}_{c,i} = \sum_{j \in S} \widehat{V}_{c,j} (B_{c,c})_{ji} \text{EXGR}_{c,i}$$

**Foreign services value added share in gross exports, percentage**

*Dimension: [VA src cou | VA src ind | Foreign]*

$$\text{EXGR\_SERV\_FVASH}_{c,i} = \frac{\text{EXGR\_SERV\_FVA}_{c,i}}{\text{EXGR}_{c,i}} \times 100$$

where:

$$\text{EXGR\_SERV\_FVA}_{c,i} = \sum_p \sum_{j \in S} \widehat{V}_{p,j} (B_{p,c})_{ji} \text{EXGR}_{c,p,i}$$

## VALUE ADDED ORIGIN BY SOURCE COUNTRY AND INDUSTRY (BSCI)

### Origin of value added in gross exports, USD million

*Dimension: [VA src cou | VA src ind | Exp cou | Exp ind]*

Origin of value added in gross exports by source country and industry has four dimensions linking exports by industry  $j$  in country  $p$  and to value added generated by industry  $i$  in country  $c$ :

- Country of value added origin  $c$
- Industry of value added origin  $i$
- Exporting country  $p$
- Exporting industry  $j$

$$EXGR\_BSCI_{c,i,p,j} = (\widehat{VB} EXGR_{p,j})_{c,i}$$

Where  $EXGR_{p,j}$  is a vector of size  $KN \times 1$ , with all entries being zero except the entry corresponding to exports by country  $p$ 's industry  $j$ .  $\widehat{VB} EXGR_{p,j}$  is a vector of size  $KN \times 1$  as well and  $(\widehat{VB} EXGR_{p,j})_{c,i}$  is the vector element corresponding to value adding country  $c$ 's industry  $i$ .

### Origin of value added in final demand, USD million

*Dimension: [VA src cou | VA src ind | Exp cou | Exp ind]*

Origin of value added in final demand by source country and industry has four dimensions linking demand for industry  $j$  final goods in country  $p$  to value added generated by industry  $i$  in country  $c$ :

- Country of value added origin  $c$
- Industry of value added origin  $i$
- Final demand country  $p$
- Final demand industry  $j$

$$FDVA\_BSCI_{c,i,p,j} = (\widehat{VB} FD_{p,j})_{c,i}$$

Where  $FD_{p,j}$  is a vector of size  $KN \times 1$ , with all entries being zero except the entry corresponding to final demand for goods and services of industry  $j$  in country  $p$ .  $\widehat{VB} FD_{p,j}$  is a vector of size  $KN \times 1$  as well and  $(\widehat{VB} FD_{p,j})_{c,i}$  is the vector element corresponding to value adding country  $c$ 's industry  $i$ .

**Origin of value added in gross imports, USD million**

*Dimension: [Imp cou | VA src cou | Exp ind | Exp cou]*

This indicator calculates the origin of value added embodied in total gross imports of the importing country  $c$  by value added source country and exporting industry and country, it has four dimensions, linking the imports of country  $c$ , to the value added from source country  $s$ , embodied in the exports of industry  $j$  in the exporting country  $p$ .

$$IMGR\_BSCI_{c,s,j,p} = \hat{V}BIMGR_{pc}$$

Where  $IMGR_{p,c}$  is a diagonal matrix of size  $KN \times KN$ , with the gross imports of country  $c$  from the exporting industries of the partners' countries  $p$ .

## VALUE ADDED EMBODIED IN EXPORTS BY FINAL DESTINATION

**Value added embodied in intermediate products exports by final destination, USD million**

*Dimension: [VA src cou | Exp cou | Exp ind | Dem cou]*

This indicator calculates the source of value added embodied in intermediate products exports by country  $d$  of final destination. The value added has its origin on the inputs from source country  $c$  used by the exporting industry  $j$  of the exporting country  $p$ .

$$FD\_EXGRINT\_VA_{c,p,j,d} = V_{c,i} * B_{c,i,p,j} * F_{p,j,d}$$

Where:

$$F = diag\{\gamma \circ A * diag(B * FD)\} * i\}$$

$\gamma$  is a matrix with ones in the off main block diagonals and zeros in the main block diagonals, i.e., zeros for the block diagonal of the same country of origin and destination

$\circ$  is the symbol for the Hadamard product, i.e., the element-wise multiplication

$i$  is a vector of ones

**Value added embodied in final products exports by final destination, USD million**

*Dimension: [VA src cou | Exp cou | Exp ind | Dem cou]*

This indicator calculates the source of value added embodied in final products exports by country  $d$  of final destination. The value added has its origin on the inputs from source country  $c$  used by the exporting industry  $j$  of the exporting country  $p$ .

$$FD\_EXGRFNL\_VA_{c,p,j,d} = V_{c,i} * B_{c,i,p,j} * EXGR\_FNL_{p,j,d}$$

**Value added embodied in total gross exports by final destination, USD million**

*Dimension: [VA src cou | Exp cou | Exp ind | Dem cou]*

This indicator calculates the source of value added embodied in total gross exports by country  $d$  of final destination. The value added has its origin on the inputs from source country  $c$  used by the exporting industry  $j$  of the exporting country  $p$ .

$$FD\_EXGR\_VA_{c,p,j,d} = FD\_EXGRINT\_VA_{c,p,j,d} + FD\_EXGRFNL\_VA_{c,p,j,d}$$

## BACKWARD AND FORWARD PARTICIPATION IN GVCs

### Backward participation in GVCs, percentage

*Dimension: [VA src cou | VA src ind | Exp cou]*

Foreign VA embodied in exports, as % of total gross exports of the exporting country.

This indicator is calculated for the total value of source and exporting industries; it is estimated as the ratio between the VA contents of imports from the source country and the gross exports of the exporting country.

This indicator is estimated as:

$$DEXFVApSH_{cp} = \frac{EXGR\_BSCI_{ci_t p i_t}}{EXGR_p} \times 100$$

Where  $EXGR\_BSCI_{ci_t p i_t}$  is the total VA from country  $c$  embodied in the total exports of country  $p$ , and  $EXGR_p$  is the total gross exports of country  $p$ .

### Forward participation in GVCs, percentage

*Dimension: [VA src cou | VA src ind | Exp cou]*

Domestic VA embodied in foreign exports, as % of total gross exports of the source country.

This indicator is calculated for the total value of source and exporting industries; it is estimated as being the VA contents of exports originated in the source country, and embodied in the exports of the exporting country, divided by the gross exports of the source country.

This indicator is estimated as:

$$FEXDVApSH_{cp} = \frac{EXGR\_BSCI_{ci_t p i_t}}{EXGR_c} \times 100$$

Where  $EXGR\_BSCI_{ci_t p i_t}$  is the total VA from country  $c$  embodied in the exports of country  $p$ , and  $EXGR_c$  is the total gross exports of country  $c$ .