Measuring value chains - Use of input-output tables

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“The Gambia’s transport sector: Measuring its value chain and exploiting its potential”

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Context

In development studies, the global value chain (GVC) describes the people and activities involved in the production of a good or service and its supply, distribution, and post-sales activities (also known as the supply chain) when activities must be coordinated across geographies. GVC is similar to Industry Level Value Chain but encompasses operations at the global level.

Objective:
- Better assess the contribution of services to regional value chains
- Provide good indicators for Measuring value chains
Two methodological approaches to the study of services in regional value chains:

- **Qualitative approach**, based on firm-level interviews as the basis for case studies,
- **Quantitative approach** using multi-region input output tables (MRIOs), based on the literature on trade in value added.

The quantitative approach

- based on the literature on trade in value added,
- uses multi-region input output tables (MRIOs),
- uses algebraic formula and computation in software like R
Outlet

1. Literature on trade in value added
2. Input-Output table
3. How to measure the DVA, GVC?
4. Outcomes
5. Application in the context of transport sectors
6. What is needed to get data/analysis
7. Quality of data
8. ECA contribution
1. Literature on trade in value added

- Shepherd, B. GVCs Methodology Paper, Jan 2019, ...
2. Input-Output table
2. Input-Output table

Source: OECD (2012).
## 2. Input-Output table

**Input-Output Table:** Intermediate Use + Finale Use = Production

<table>
<thead>
<tr>
<th>Intermediary Use</th>
<th>Final Demand</th>
<th>Gross Output</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Country A</td>
<td>Country B</td>
</tr>
<tr>
<td>Sector 1A</td>
<td>Sector 1B</td>
<td>Sector 2A</td>
</tr>
<tr>
<td>Sector 2A</td>
<td>Sector 1B</td>
<td>Sector 2B</td>
</tr>
</tbody>
</table>

- **Intermediate Use**:
  - Country A: Sector 1A, Sector 2A
  - Country B: Sector 1B, Sector 2B

- **Final Demand**:
  - Country A: Sector 1B, Sector 2B
  - Country B: Sector 1B, Sector 2B

- **Gross Output**:
  - Country A: Sector 1A, Sector 2A
  - Country B: Sector 1B, Sector 2B
2. Input-Output table

**Example:** Consider 3 countries (G=3) and 4 sectors (N=4) in each country, so 12 sectors in all (GN = 12) as in the figure.

### Year: 2000

<table>
<thead>
<tr>
<th>Year 2000</th>
<th>Final Demand (FD) Matrix</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>T matrix</strong></td>
<td>Country 1</td>
</tr>
<tr>
<td></td>
<td>Sector 1</td>
</tr>
<tr>
<td>Country 1</td>
<td>346</td>
</tr>
<tr>
<td>Country 2</td>
<td>354</td>
</tr>
<tr>
<td>Country 3</td>
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<td>Country 4</td>
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<td>Country 1</td>
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<tr>
<td>Country 1</td>
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<tr>
<td>Country 2</td>
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<tr>
<td>Country 3</td>
<td>531</td>
</tr>
<tr>
<td>Country 4</td>
<td>857</td>
</tr>
</tbody>
</table>

### VA matrix

<table>
<thead>
<tr>
<th>Year 2000</th>
<th>Value Added</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Country 1</strong></td>
<td>1,172</td>
</tr>
<tr>
<td><strong>Country 2</strong></td>
<td>-</td>
</tr>
<tr>
<td><strong>Country 3</strong></td>
<td>-</td>
</tr>
</tbody>
</table>

| Total Input | 6,901 | 6,657 | 7,518 | 7,868 | 7,864 | 9,511 | 7,117 | 6,677 | 7,082 | 6,445 | 7,326 | 8,612 | 89,576 |
2. Input-Output table

- Note: These numbers are just some example and not real numbers

<table>
<thead>
<tr>
<th></th>
<th>Kenya</th>
<th>Ethiopia</th>
<th>Nigeria</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Agri</td>
<td>Mining</td>
<td>Transp</td>
<td>finance</td>
</tr>
<tr>
<td>Kenya</td>
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<td>828</td>
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<td>finance</td>
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<td>191</td>
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<td>776</td>
<td>897</td>
<td>18</td>
</tr>
</tbody>
</table>

Note: These numbers are just some example and not real numbers.
2. Input-Output table

- Two parts: Intermediate Use & Finale Use
- Many countries that interact
  - Production, gross Exportations, gross Importations, Values added, GVC participation Index, ...
- The Intermediate Use is square matrix
  - Same country-sectors on row and column
  - Intermediate Use of domestic output on diagonal parts
  - Off diagonal elements represent exports of intermediates
- Final consumption from output of each sector
2. Input-Output table

Difference between Supply-Use-Tables (SUTs) and Input-Output Tables

- In SUT, there are 2 tables: Supply Table (Production and Importation) and Use Table (Intermediate and Final Consumptions, and Exportation)

- In SUT, exportations and importations are aggregate, no need to know the origin while in Multi-Region Input Output (MRIO), it is needed to know the origin

- In MRIO, knowledge of the using of exportations and importations
  - Whether for intermediate or final uses,
  - Using by which sector for Intermediate Use

- The Intermediate Use in SUT is not square matrix
  - Products on row and industries on column

- National input-output tables is derived from harmonized national supply and use tables with international trade in goods and services statistics

- The SUTs are very useful to compile Input-Output table, but not enough. Information from foreign is necessary
3. How to measure the DVA, GVC?

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Total input | 6,901 | 6,657 | 7,518 | 7,868 | 7,864 | 9,511 | 7,117 | 6,677 | 7,082 | 6,445 | 7,326 | 8,612 | 89,578
3. How to measure the DVA, GVC?

Starting from $AX + Y = X$, we can perform some rearrangements, and solve for $X$: (no worry about compatibility of matrix size)

- $Y = X - AX$
- $\therefore X = (I - A)^{-1}Y \equiv BY$

$\hat{V}$ as the value added coefficients matrix:

$E$ with gross exports by country-sector on the main diagonal, and zeros elsewhere

$T_v = \hat{V}BE = \begin{bmatrix} \hat{v}_1 & 0 & \cdots & b_{11} & b_{12} & \cdots & e_1 & 0 & \cdots \\ 0 & \hat{v}_2 & 0 & b_{21} & b_{22} & \cdots & e_2 & 0 & \cdots \\ \vdots & 0 & \ddots & \vdots & \vdots & \ddots & \vdots & 0 & \ddots \\ \end{bmatrix}$
3. How to measure the DVA, GVC?

For application, many softwares could be used. UNCTAD has developed a methodology on R.

In the knowledge sharing platform of the project, there is an online course which will facilitate the learning of the quantitative tool. https://knowledge.uneca.org/stp/
4. Outcomes

Allow to know the requirements for an extra unit of output in each country-sector. If a sector in a country needs an extra unit of output:

- Determine the direct input requirements for each country-sector: input-output coefficients or matrix of technical coefficients

<table>
<thead>
<tr>
<th></th>
<th>C1: S1</th>
<th>C1: S2</th>
<th>C1: S3</th>
<th>C1: S4</th>
<th>C2: S1</th>
<th>C2: S2</th>
<th>C2: S3</th>
<th>C2: S4</th>
<th>C3: S1</th>
<th>C3: S2</th>
<th>C3: S3</th>
<th>C3: S4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Country 1: S1</td>
<td>0.050</td>
<td>0.023</td>
<td>0.013</td>
<td>0.076</td>
<td>0.104</td>
<td>0.016</td>
<td>0.117</td>
<td>0.059</td>
<td>0.058</td>
<td>0.087</td>
<td>0.033</td>
<td>0.064</td>
</tr>
<tr>
<td>Country 1: S2</td>
<td>0.051</td>
<td>0.067</td>
<td>0.001</td>
<td>0.115</td>
<td>0.005</td>
<td>0.010</td>
<td>0.079</td>
<td>0.126</td>
<td>0.066</td>
<td>0.119</td>
<td>0.011</td>
<td>0.043</td>
</tr>
<tr>
<td>Country 1: S3</td>
<td>0.042</td>
<td>0.119</td>
<td>0.032</td>
<td>0.105</td>
<td>0.096</td>
<td>0.000</td>
<td>0.048</td>
<td>0.035</td>
<td>0.035</td>
<td>0.094</td>
<td>0.072</td>
<td>0.071</td>
</tr>
</tbody>
</table>

- Determine the total (direct & indirect) input requirements for each country-sector:
4. Outcomes

The Domestic Value Added (DVA) in exports are the value added in exports whose the outputs are produced by domestic industries.

The Foreign Value Added (FVA) in exports are the value added in exports whose the outputs are produced by foreign industries.

- Known as “VS” in the technical literature.
- Known of backward participation in the policy literature.

The Indirect Domestic Value added (DVX) in exports, i.e., Value Added that is embodied in the exports of other countries, upstream contributions of DVA of other industries.

- Known as “VS1” in the technical literature.
- Known as forward linkages in the policy literature.

GVC Participation Index \((VS+VS1)/Gross\ Exports\) is the best indicator which shows how the sector involved in RVCs/GVCs through both backward and forward linkages.
5. Application in the context of transport sectors

- Quantifying the value generated in the transport value chain makes it possible
  - to identify which type of transport activities add more value, ..
  - better understanding of these bilateral exchanges (the direct and indirect impacts of transport)
  - identification of source markets which generate more value added in the domestic economy.
  - how upstream domestic industries (backward linkages) contribute to transport exports
  - Whether the increased participation in GVCs can be good for economic growth and social development.
5. Application in the context of transport sectors

- Quantifying the value generated in the transport value chain makes it possible
  - help to respond to key policy/statistics questions such as:
    - How much value does transport add to economies?
    - Does transport create additional trade?
    - Do transport services have ‘high or low’ domestic value added content?
    - How does transport compare to the rest of the economy?
    - What is the upstream impact of transport on other domestic industries?
5. Application in the context of transport sectors

Transport sectors includes:

- **Transport Equipment:**
  - 1. Motor vehicles, trailers and semi-trailers; parts and accessories thereof
  - 2. Bodies (coachwork) for motor vehicles; trailers and semi-trailers; parts and accessories thereof
  - 3. Ships
  - 4. Pleasure and sporting boats
  - 5. Railway and tramway locomotives and rolling stock, and parts thereof
  - 6. Aircraft and spacecraft, and parts thereof
  - 7. Other transport equipment and parts thereof

- **Passenger Transport Services:**
  - 1. Local transport and sightseeing transportation services of passengers
  - 2. Long-distance transport services of passengers
5. Application in the context of transport sectors

Transport sectors includes:

- **Freight transport services:**
  - 1. Land transport services of freight
  - 2. Water transport services of freight
  - 3. Air and space transport services of freight

- **Rental services of transport vehicles with operators**

- **Supporting transport services:**
  - 1. Cargo handling services
  - 2. Storage and warehousing services
  - 3. Supporting services for railway transport
  - 4. Supporting services for road transport
  - 5. Supporting services for water transport
  - 6. Supporting services for air or space transport
  - 7. Other supporting transport services

- **Postal and courier services**
6. GVC outcomes

GVC participation indices, 2011

- Highest for high income,
- Lowest for low income
- Lowest in South Asia, then Latin America
- Highest in Europe and Central Asia
- In MENA, the forward linkages are among the highest while the backward linkages are among the lowest

Source: Shepherd (Forthcoming), based on Kowalski et al. (2015).

Notes: Geographical regions exclude high-income countries. All figures that present data by developing region or income group use simple averages across the countries in the relevant group, in accordance with standard practice.
6. GVC outcomes

- Domestic and foreign value added content of gross exports, million USD, in Thailand’s transport equipment industry in 1995 and 2011.

- Source: OECD-WTO TiVA.
6. GVC outcomes

- Domestic and foreign value added content of gross exports, shares, in Thailand’s transport equipment industry in 1995 and 2011.

- Source: OECD-WTO TiVA.
6. GVC outcomes

- Domestic and foreign value added content of gross exports, thousand USD in Ethiopia’s textiles and apparel sector, 1996 and 2011.

- Source: Eora MRIO database
6. GVC outcomes

Domestic and foreign value added content of gross exports, shares, in Ethiopia’s textiles and apparel sector in 1996 and 2011.

Source: Eora MRIO database
7. Quality of data

Bases on some questions:

1. Is the data publicly available for stakeholders and users?
   - In which format (Excel, Stata, Word, PDF, html, ...)?
   - Need to register?
   - Need password?
2. When was the most recent data produce?
3. How frequently is the data produced? (Quarterly, Annually, 5 years)
4. What methodology is used?
   - Are international guidelines followed?
   - Are International classification used (CPC, ISIC)?
5. Are data comparable year to year? Is the same methodology used each year?
6. Is there metadata?
7. Is data collected or estimated?
7. Quality of data

- **Prerequisites of quality.** Prerequisites of quality refer to all institutional and organizational conditions that have an impact on the quality of transport statistics. These include:
  - the legal basis for compilation of data;
  - the adequacy of data sharing and coordination among data producing agencies;
  - assurance of confidentiality;
  - the adequacy of human, financial, and technical resources for implementation of transport statistics programmes and implementation of measures to ensure the cost-effective; and
  - quality awareness;

- **Relevance.** The relevance of transport statistics reflects the degree to which transport statistics meet users’ needs.
  - Absence of significant gaps between the key user needs and compiled transport statistics in terms of variables, coverage and details is an indicator of relevance;

- **Credibility.** The credibility of transport statistics refers to the confidence that users place in the data based on the image of the agency responsible for production and dissemination of the data.
  - Indicators of credibility should provide evidence that production of transport statistics is not manipulated and that their release is not timed in response to political pressure;
7. Quality of data

- **Accuracy.** The accuracy of transport statistics is the degree to which the data correctly estimate or describe the quantities or characteristics they are designed to measure.
  - In general, accuracy can be characterized in terms of errors in statistical estimates and is traditionally decomposed into bias (systematic error) and variance (random error) components.

- **Validity** refers to whether a data collection tool or concept truly captures what it is intended to measure. In other words, a variable or measure is valid if the values estimated are close to the true values.

- **Reliability** of data refers to whether the instrument or source of the data would produce consistent results under identical circumstances regardless of who uses it.

- **Precision** refers to an aspect of the reporting of data, or of statistics or indices derived from original data and is not, in itself, an intrinsic quality of the original data.
7. Quality of data

- **Timeliness.** The timeliness of transport statistics refers to the delay between the end of the reference period to which the data pertain and the date on which the data are released and available to the public.
  
  - This dimension usually involves a trade-off against accuracy. The timeliness of information also influences its relevance, as accurate data that are not timely are of limited usefulness;

- **Methodological soundness.** The methodological soundness of a data source refers to the application of international standards, guidelines and good practices in production of transport statistics.
  
  - Metadata provided along with transport statistics play a crucial role for assessing the methodological soundness of data
  
  - The methodological soundness is closely related to the interpretability of data.
7. Quality of data

- **Coherence.** Coherence reflects the degree to which the data are logically connected and mutually consistent, that is, they can be successfully brought together with other statistical information within a broad analytical framework and over time.
  - The use of standard concepts, classifications and target populations promotes coherence, as does the use of common methodology across surveys when relevant.
  - Coherence has four important subdimensions:
    1. **Coherence within a data set** implies that the elementary data items are based on compatible concepts, definitions and classifications and can be meaningfully combined;
    2. **Coherence across data sets** implies that the data are based on common concepts, definitions and classifications, or that any differences are explained and can be allowed for;
    3. **Coherence over time** implies that the data are based on common concepts, definitions and methodology over time, or that any differences are explained and can be allowed for; and
    4. **Coherence across countries** implies that the data are based on common concepts, definitions and methodology over countries, or that any differences are explained and can be allowed for;
7. Quality of data

- **Accessibility.** The accessibility of transport statistics refers to the ease with which they can be obtained from those agencies active in transport statistics.
  - This includes the ease with which the existence of information can be ascertained, as well as the suitability of the form or the media of dissemination through which the information can be accessed.
  - Accessibility requires the development of an advance release calendar so the users will be informed well in advance about when the data will become available, and where and how to access them.
  - The availability of metadata significantly improves accessibility and is, together with the existence of user support services, an indicator of this quality dimension.
ECA contribution

Use of input-output tables in countries with similar structure

- In Africa, only 29 countries out of 54 African countries have at least a Supply Use Table,
- 25 African countries have never compiled Supply Use Table,
- UNECA is estimating Supply Use Tables for these 25 African countries,
- Using technical coefficients (shares of outputs used as intermediate use) to build Intermediate consumption for each industry
- Countries with similar structure of industrial development
  - It can be one country or a group of countries
- With the same manner, it is possible to estimate input-out tables, but:
  - These estimations are inevitably biased,
  - The best compilations are from surveys
ECA contribution

ECA capacity building

- Three phases:
  - E-trainings to form a large participants with little costs
  - Seminar face-to-face
  - Workshops and follow-up activities
- Official requests of the country
- Fill questionnaires of data availability
Conclusion

- Steps for the quantitative approach:
  - Building the Input-Output Table,
  - Using algebraic models or application in software,
  - Know the outcomes,

- Quality of data
Thank You