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International Trade in Value Added: Some Suggestions for Improved and New Indicators

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Abstract

Modern production methods utilize complex, international business models that result in global value chains (GVCs). The OECD/WTO database on trade in value added (TiVA) estimates these trade flows based on official statistics. Using the TiVA dataset, this paper outlines the so-called 'profiles by country' used for analytical purposes and makes some suggestions for how indicators, such as the GVC participation index; the length of GVCs might be improved.

Keywords: Global Value Chains, GVC Participation Index, GVC Length Index, GVC-Oriented FDI.

1. Introduction

Many firms today, in particular multi-national firms, utilize complex production methods and business function models. These complex models, which involve multi-location production and

international sourcing of intermediate goods and services result in Global Value Chains (GVCs). Using the OECD/WTO database on Trade in Value Added (TiVA) this paper outlines some analytical indicators, such as the GVC participation index and the length of GVCs. The paper also discusses how these indicators might be improved and outlines how other interesting indicators, such as a measure of GVC-oriented FDI might be compiled.

2. GVC Participation

Measuring trade related to global production requires complementing traditional trade statistics with information on the domestic and foreign origin of inputs. The OECD-WTO project on estimating trade in value added, carried out in close cooperation with other national and international organizations, has led to a first interactive database that provides such information for users[1].

Indicators included in the TiVA database are based on the OECD inter-country input-output (ICIO) table which covers both goods and services classified by partner and sector. TiVA currently provides free access to indicators for 61 economies and 34 industries. Data are available for three historical benchmarks for 1995, 2000 and 2005 and continuous data for the period 2008-2011.

The decomposition of gross exports into domestic and foreign value added components allows trade taking place within GVCs to be tracked. Trade in this context refers to the exchange of intermediate goods and services within vertical production chains. The 'GVC participation index' proposed by Koopman et al. (2010) illustrates this 'Trade in Tasks' phenomenon and the multiple value added exchanges taking place within international production. GVC participation can be broken down in two components related to backward and forward linkages of a country with its foreign partners.

Backward participation in GVCs refers to the foreign value added content of exports, also referred to as vertical specialization. This concept, developed by Hummels et al. (2001) corresponds to the value added from inputs that were imported in order to produce intermediate or final goods and services for export. This is the 'Buyer' perspective or sourcing side in GVCs, where a country imports intermediates to produce exports. Forward participation to GVCs captures the domestic value added contained in inputs sent to third countries for further processing and exporting through a value chain. This is the 'seller-related' measure or supply side in the GVC participation index.

The calculation of the two components of the GVC participation index are derived from the following matrix: $VLE=Vx(I-A)^{-1x}E$ (see schema in Figure 1).

[1] See http://stats.oecd.org/Index.aspx?DataSetCode=TIVA_OECD_WTO or http://www.wto.org/miwi.

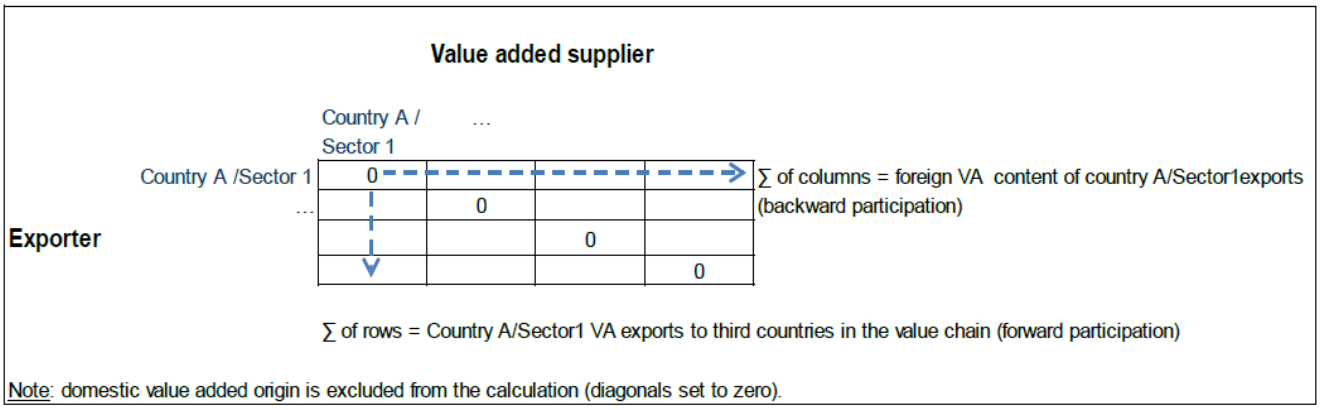
Where:

V = diagonal matrix of the vector of direct value added coefficients, derived from the ICIO table.

L = global Leontief inverse matrix.

E = diagonal matrix of the vector of total gross exports.

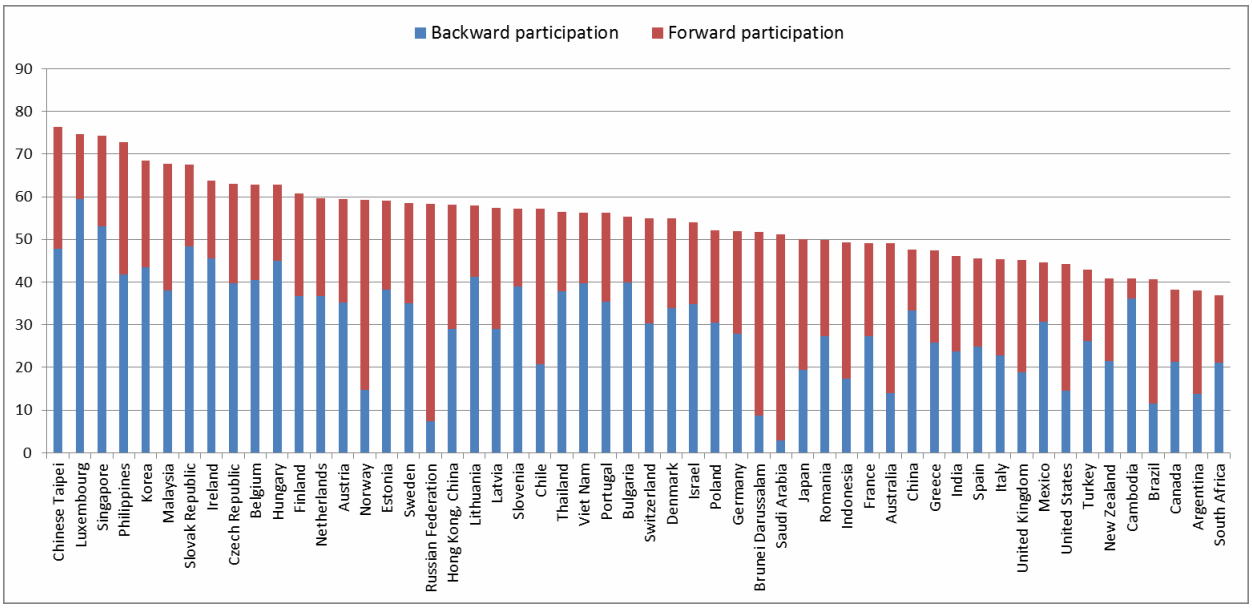
Figure 1. Schematic presentation of backward and forward participation to GVCs (VLE matrix)



Source: WTO

The GVC participation index highlights useful elements on the implication, role and position of economies within GVCs. For example, Chinese Taipei plays an important role in GVCs, with around 75% of its exports taking place within production networks. As far as forward linkages are concerned, Chinese Taipei exports more and more manufactured intermediate goods to Asian partners such as China and the Association of South East Asian Nations (ASEAN). Other South East Asia economies like Singapore, the Philippines, Korea or Malaysia also have high GVC participation shares, accounting for around 70% of their total gross exports, confirming the position of 'Factory Asia' as a major actor in world production chains. Generally speaking, the engagement of Asian developing economies in GVCs has acted as a catalyst for their economic development including that of their domestic markets.

Figure 2. The GVC participation index - Backward and forward linkages, selected economies, 2008 (% share of gross exports)



Source: OECD-WTO TiVA Database

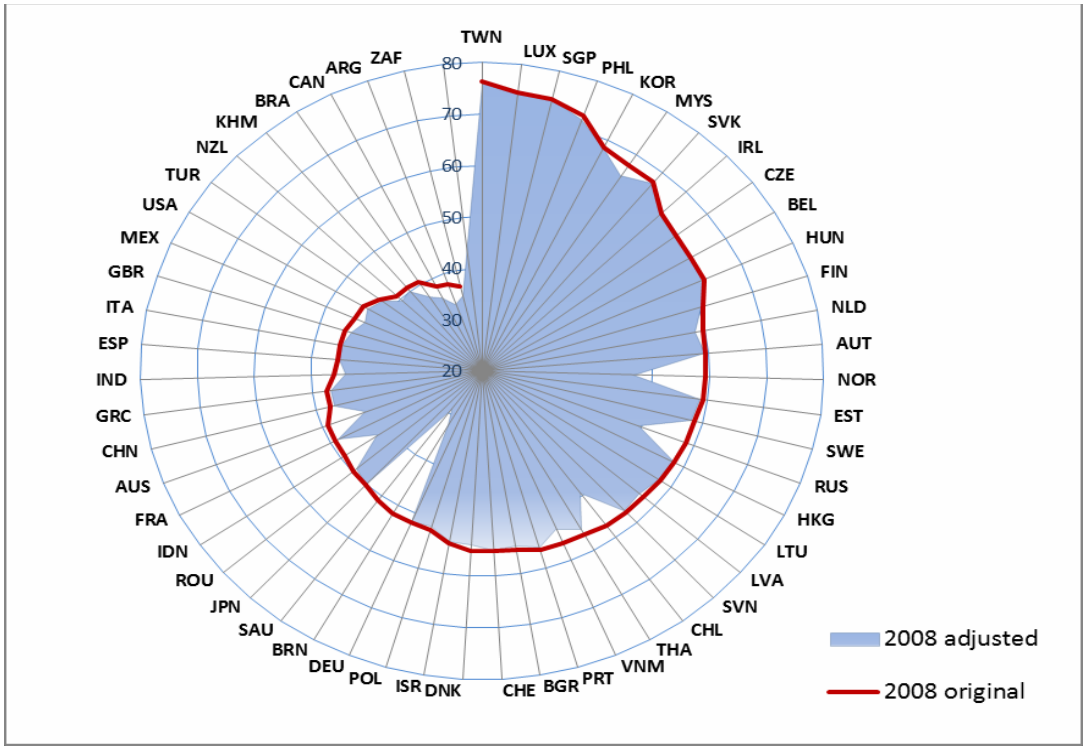
The size of an economy may impact on the way it contributes to GVCs and thereby on its dependency vis-à-vis international production networks. Indeed, small countries like Luxembourg, Ireland or the Slovak Republic source a large part of their inputs from abroad whereas major developed economies utilise inputs from their domestic value chains to a greater extent. For instance, the share of imported inputs in total exports (backward participation) in 2008 was 59% for Luxembourg against 15% for the United States.

Interestingly, the highest participations in forward linkages (see Figure 2) are oil exporters like Saudi Arabia, Brunei Darussalam, Russia or Norway. However, primary commodities do not necessarily imply a GVC-type long-term relationship between international buyers and sellers; and primary inputs' exporters may show in reality a low participation in GVCs. Escaith (2014) proposed a way to correct for this bias by considering only the value added exports from the secondary and tertiary sectors in the calculation of GVC participation. When doing so, it should be noted that indirect exports from primary sectors are still included. Figure 3 compares the original and the adjusted versions of the GVC participation index. Once direct exports of commodities are taken out from the calculation, natural resource exporters like Saudi Arabia, Norway or Russia show a much lower integration into GVCs.

Potentially, there is room to further improve the GVC participation indices, by excluding commodities that are only very slightly processed but nevertheless still classified as processed manufacture, such as, iron and steel products or fuel derivatives. On the other end of the chain, some tertiary activities could also be removed from the calculation, like the distribution sector, which does not necessarily involve GVC-related relationships.

The WTO is currently investigating for "GVC and TiVA country profiles" to facilitate the understanding and use of TiVA-related indicators, see the annex.

Figure 3. The GVC participation index - Original and adjusted version, selected economies, 2008



Source: Escaith (2014)

3. GVC Length

While the GVC participation index estimates to some extent the depth of GVCs, other indicators attempt to estimate the length of international chains. Two such indicators are proposed: Dietzenbacher and Romero (2007) suggest the "Average propagation length" (APL) indicator that estimates GVCs' length based on the input-output model. Still using input-output tables, Fally (2012) developed an index

estimating the number of production stages, based on the following definition:

$N = u \, x(I-A)^{-1}$

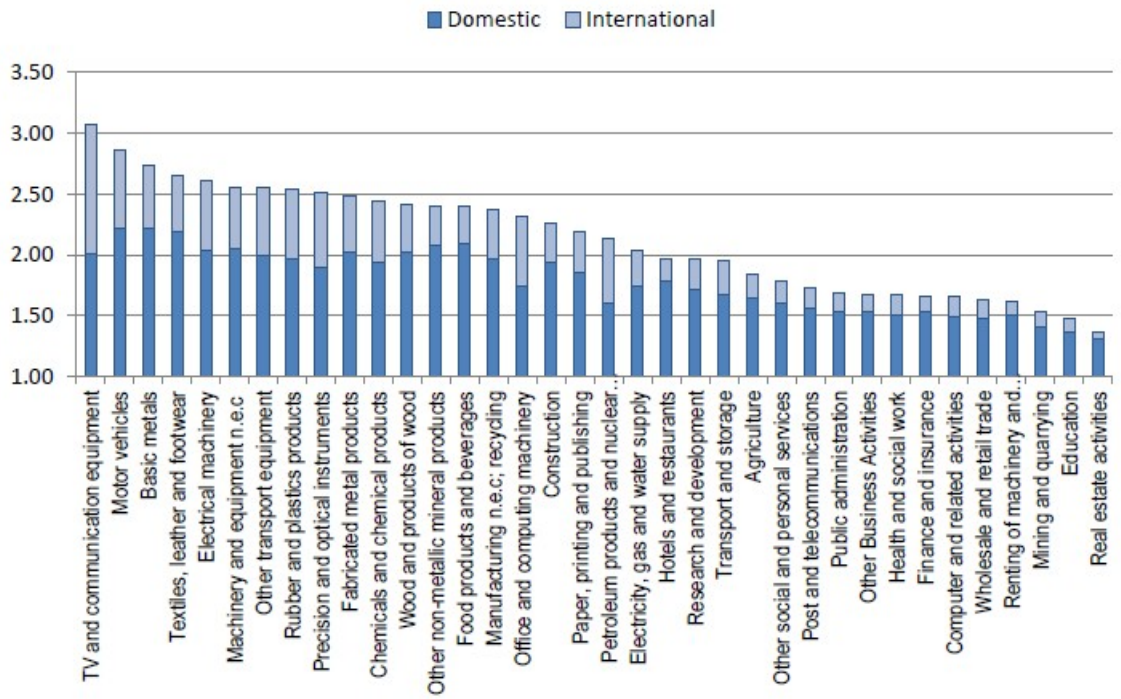
Where:

u = column unit vector.

$(I-A)^{-1}$ = Leontief inverse matrix.

Figure 4 presents the length of value chains at the industry level. The index equals 1 when only a single stage is involved in the production of a good or service, and the value increases when inputs from the referred industry or other industries are used. Technology-related sectors, like 'TV and communication equipment' or 'Motor vehicles', have long production chains whereas services industries involve fewer production stages, like 'Computer and related activities'. As shown at the far right of the graph, some industries such as 'Education' or 'real estate activities' rely on very short production chains, with few intermediate stages.

Figure 4. GVC length by industry, 2008



Source: Backer and Miroudot (2013)

4. GVC-Oriented Investment

The development of GVCs in the last decades has been largely driven by Multi-National Enterprises (MNEs) through Foreign Direct Investment (FDI). In other words, FDI policy is an important determinant in the development of GVCs. For example, the so-called 'greenfield' mode of investment, which consists of creating a subsidiary from ground-zero, is often applied by MNEs in developing economies and tends to foster forward linkages. Moreover, FDI devoted to the development of Export Processing Zones (EPZ) may boost backward linkages since EPZ production and exports mainly rely on imported inputs.

Inward FDI stock can be used as a proxy to outline GVC-oriented FDI. In a recent report, the OECD (2015) studied the correlation between the share of inward FDI stocks (as a percentage of GDP) and the two GVC participation components. The results show a positive correlation between FDI openness and backward participation and a negative one with forward linkages. This would tend suggest that inward FDI flows are more inclined to be established through foreign subsidiaries who tend to import inputs for export than create value added from the FDI recipient country. The 2013 World Investment Report (UNCTAD, 2013) also finds a positive correlation between GVC participation and stock of FDI inward.

5. Conclusions

This paper has shown that a number of useful indicators can be derived from the TiVA database to illustrate the prevalence of GVCs to an economy, the inter-linkages with other sectors and the length of global linkages. At an international level, more can undoubtedly be done to derive other policy relevant data and indicators, such as GVC-Oriented FDI (something WTO and UNCTAD will continue to work on in the future) and agree on the best methods for developing these tools, for example, reaching a consensus on how best to construct global IO tables, which underpin many of these analyses.

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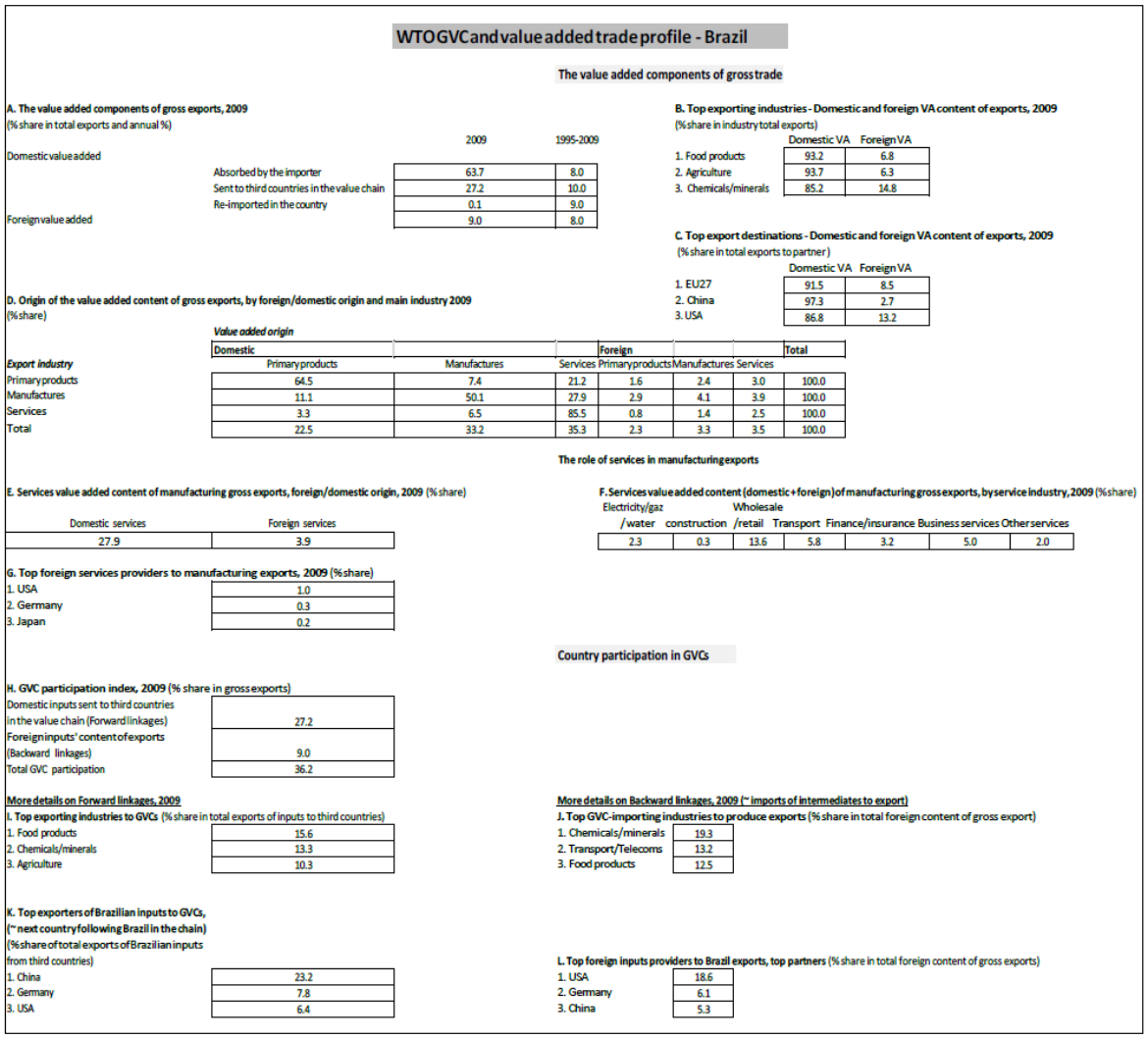
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Annex 2. An example of the WTO 'GVC and trade in value added country profiles' (Preliminary version)



WTO GVC and value added trade profile - Brazil

The value added components of gross trade

A. The value added components of gross exports, 2009
(% share in total exports and annual %)

		2009	1995-2009
Domestic value added			
	Absorbed by the importer	63.7	8.0
	Sent to third countries in the value chain	27.2	10.0
	Re-imported in the country	0.1	9.0
Foreign value added		9.0	8.0

B. Top exporting industries - Domestic and foreign VA content of exports, 2009
(% share in industry total exports)

	Domestic VA	Foreign VA
1. Food products	93.2	6.8
2. Agriculture	93.7	6.3
3. Chemicals/minerals	85.2	14.8

C. Top export destinations - Domestic and foreign VA content of exports, 2009
(% share in total exports to partner)

	Domestic VA	Foreign VA
1. EU27	91.5	8.5
2. China	97.3	2.7
3. USA	86.8	13.2

D. Origin of the value added content of gross exports, by foreign/domestic origin and main industry 2009
(% share)

	Value added origin						
	Domestic			Foreign			Total
Export industry	Primary products	Manufactures	Services	Primary products	Manufactures	Services	
Primary products	64.5	7.4	21.2	1.6	2.4	3.0	100.0
Manufactures	11.1	50.1	27.9	2.9	4.1	3.9	100.0
Services	3.3	6.5	85.5	0.8	1.4	2.5	100.0
Total	22.5	33.2	35.3	2.3	3.3	3.5	100.0

The role of services in manufacturing exports

E. Services value added content of manufacturing gross exports, foreign/domestic origin, 2009 (% share)

Domestic services	Foreign services
27.9	3.9

F. Services value added content (domestic + foreign) of manufacturing gross exports, by service industry, 2009 (% share)

Electricity/gaz /water	construction	Wholesale /retail	Transport	Finance/insurance	Business services	Other services
2.3	0.3	13.6	5.8	3.2	5.0	2.0

G. Top foreign services providers to manufacturing exports, 2009 (% share)

1. USA	1.0
2. Germany	0.3
3. Japan	0.2

Country participation in GVCs

H. GVC participation index, 2009 (% share in gross exports)

Domestic inputs sent to third countries in the value chain (Forward linkages)	27.2
Foreign inputs' content of exports (Backward linkages)	9.0
Total GVC participation	36.2

More details on Forward linkages, 2009

I. Top exporting industries to GVCs (% share in total exports of inputs to third countries)

1. Food products	15.6
2. Chemicals/minerals	13.3
3. Agriculture	10.3

More details on Backward linkages, 2009 (~ imports of intermediates to export)

J. Top GVC-importing industries to produce exports (% share in total foreign content of gross export)

1. Chemicals/minerals	19.3
2. Transport/Telecoms	13.2
3. Food products	12.5

K. Top exporters of Brazilian inputs to GVCs, (~ next country following Brazil in the chain)
(% share of total exports of Brazilian inputs from third countries)

1. China	23.2
2. Germany	7.8
3. USA	6.4

L. Top foreign inputs providers to Brazil exports, top partners (% share in total foreign content of gross exports)

1. USA	18.6
2. Germany	6.1
3. China	5.3