Paper to be presented at the 25th International Input-Output Conference in Atlantic City

Vertical Specialization in Manufacturing and Service Sectors of the Indian Economy

Priyanka Tariyal
Kurukshetra University (Pursuing Ph.D)
Kurukshetra, Haryana- 136119 (India)
Junior Research Consultant,
National Human Rights Commission, INA, New Delhi, Delhi 110023
E-mail:priyanka.tariyal88@gmail.com
Mob: +91-9953845061

Abstract

India has emerged as one of the fastest growing economies in Asia. This transition to the high economic growth path is widely believed to have been triggered by accelerated growth of services that has fared better than manufacturing, in terms of increasing sectoral share in gross domestic product (GDP) and total employment. The government of India is currently concerned with engineering further economic transformation and thus, has launched it's 'Make in India' national programme wherein, greater emphasis is being placed on foreign and local investments in 25 focus sectors to transform India into a global manufacturing powerhouse. Therefore, greater integration of domestic industries with global production networks must form an essential part of Make in India initiative. Against this backdrop, the objective of this paper is to estimate the extent of integration of Indian manufacturing and service sector into the global value chains. There are various ways to measure the economic participation in global value chains and a more rigorous measure is vertical specialization. Using Koopman, Wang and Wei (2012) Value Added in Trade method, the study estimates domestic and foreign value added in India's exports at aggregate level to quantify the vertical specialization and subsequently Trade in Value Added method is used to calculate India`s value added trade disaggregated by industry. The calculations are based on recently published World Input Output Database (Timmer, M.P, Los.B, Stehrer. R, and .G.J Vries, 2016). We compare the data for first and final years available in WIOD, 2000 and 2014. For the purpose of analysis the WIOD countries have been combined other than India into 5 countries and two destination regions (the United States, China, Japan, Korea, Taiwan, the European Union and Rest of the World). The results show that during the period 2000 and 2014, the foreign value added share in exports of manufacturing industries is much higher than the foreign value added share in service exports. It is also observed that there has been a significant increase in the foreign value added share of China in India's Exports especially in key manufacturing industries like chemicals and chemical products, Basic pharmaceuticals product, Electric equipment and machinery etc. By contrast, foreign value added share of Japan and EU has decreased for both manufacturing and service sectors while the share of rest of the world has increased for both.

Key words: Vertical Specialization, Value added in Trade, Trade in Value Added, Global Networks

1. Introduction

India is a country which has experienced a growth in GDP driven by its service sector throughout the last few decades however the service led growth has largely been jobless. India is believed to have a large demographic dividend wherein the majority of the population falls in the working age group. Thus, the manufacturing sector plays an important role in generating employment as well as making the economy self-reliant. But the manufacturing sector has always been an area of concern for India due to its sticky growth rate and persistently low contribution to total output and employment in the economy (Banga, 2014).

The government of India is currently concerned with engineering further economic transformation and thus, has launched it's 'Make in India' national programme wherein, greater emphasis is being placed on foreign and local investments in 25 focus sectors to transform India into a global manufacturing powerhouse. Therefore, greater integration of domestic industries with global production networks must form an essential part of Make in India initiative. The development of production networks is widespread and their growth in East Asia and China has been particularly impressive. The experience of East Asia suggests that one of the important reasons for the lacklusture performance of the manufacturing sector is lack of its participation in global production networks. Share of services in global trade is rising rapidly and so is the role of services in GVCs. Improvements in technology, standardization, infrastructure growth, rapid advances in ICT and decreasing data transmission costs have all added to tradability of services. Against this backdrop, the objective of this paper is to estimate the extent of integration of Indian manufacturing and service sector into the global value chains. In this regard foreign value added in India's Exports at aggregate level is being estimated using value added in trade method as well as by trade in value added method. This analysis is followed by estimating foreign value added in India's exports disaggregated by industry using trade in value added method.

In the next section 2 we review vertical specialization literature and the models that propose an estimation method for vertical specialization. In section 3 we present the accounting framework for estimating domestic content and foreign content in India's Exports. In Section 4 we present estimation results for Indian manufacturing and services exports followed by Section 5 which gives the conclusion.

2. Review of literature

Rapid growth of international fragmentation particularly since 1980s has led to a major change in the nature and pattern of the world trade and thus countries are increasingly engaged in trade by specializing in particular stages of goods production rather than the final good. With the rising importance of vertical specialization in international trade many researchers have identified ways to quantify vertical specialization through an analysis of international input- output tables. Hummels, Ishii and Yi (2001) introduced measures of the import (foreign) content of exports defined as vertical specialization (VS) based on input-output tables. They decomposed a country's export into foreign value-added and domestic value-added. Their main assumption is that the intensity in the use of imported inputs is same between production for exports and production for domestic sales. They also assume that a country's exports are entirely absorbed in a final demand abroad. By implicitly adopting the HIY approach, a large number of papers used input-output tables to focus on the domestic content of Chinese exports among them, Chen, Cheng, Fung and Lau (2004), Koopman, Wang and Wei (2008), Dean, Fung and Wang (2007).

Chen et al. (2004) developed a methodological framework for the estimation of the domestic value-added and employment induced by Chinese exports to the United States. They construct from the raw data two separate input output tables one for processing exports and other for non-processing exports production. Contrary to Hummels et al. (2001), they develop a non-competitive I/O model by accounting for processing exports explicitly. One drawback of this model is that they do not describe a systematic way to estimate input-output coefficients for processing and non-processing exports. Dean et al. (2007) measure the degree to which Chinese trade has become vertically specialized, using a new measure adapted from Hummels, Ishii and Yi (2001). They identify intermediate import data with the 1997 and 2002 Chinese benchmark IO tables, to construct an improved version of the Hummels, Ishii and Yi (2001) (HIY) measure of vertical specialization. This new measure of vertical specialization is used to quantify the foreign content in Chinese global exports and bilateral exports, from 1996-2005 and the results are disaggregated by source country and by firm type. Koopman, Wang and Wei (2008) develop a general formula for computing domestic and foreign contents when processing exports are pervasive. They provide the systematic way to infer the input output coefficients for production of processing exports versus those for other final goods.

Koopman, Wang and Wei (2010) provide a conceptual framework to measure the sources of value added in the global production chains. Their framework enables a complete concordance between value added trade and official gross trade statistics. Moreover, they decompose domestic value added in exports (foreign value added in imports) into components that reveal each country's upstream and downstream positions in the global value chain. Koopman, Wang and Wei (2012) provide a unified and transparent mathematical framework to completely decompose gross exports into its various components, including exports of value added, domestic value added that returns home, foreign value added, and other additional double counted terms.

Johnson and Noguera (2012) generalize the model proposed by Hummels, Ishii and Yi (2001) to a multi-regional input-output model by relaxing the assumption that a country's exports are entirely absorbed in final demand abroad. By using input-output data for source and destination countries simultaneously, they relax this assumption. By doing so, they create a scenario in which a home country exports intermediate goods that are then used in the production of a final good in a foreign country, which is then absorbed at home country. In order to calculate value-added content of bilateral exports between source and destination, they decompose exports into three parts: absorption, reflection and redirection. Absorption refers to the part of exports which is all consumed in the final demand in the destination. Reflection refers to the part of exports which are used as intermediate inputs to produce an export good to be exported back to the source country. Finally, redirection refers to the part of exports which are used as intermediate inputs to produce an export good to be exported to a different country than the source

There are only a few studies which covers India in context of vertical specialized trade. Banga (2013) using the OECD-WTO database on Trade in Value Added estimates forward linkages (i.e., domestic value-added exports of a country which goes into exports of other countries) and backward linkages (foreign value added in gross exports of a country) in GVCs for all countries. It is observed that the developing countries, like India, Viet Nam, Thailand, Malaysia and Philippines have less than one ratio of forward to backward linkages in GVCs. Goldar, Das,

Sengupta and Das (2017) estimate and analyze the import content in Indian exports at a disaggregated industry level using the Hummel et al. (2001) approach used in this strand of empirical literature, as for instance applied by Koopmans, Wang and Wei (2008). It is found that for India's exports, the import content in exports increased steadily from about 11 percent to about 22 percent in the time period 1995 to 2011. The rise in import content was relatively greater for merchandize exports from about 11 percent in 1995 to about 26 percent in 2011. In services exports, by contrast, the foreign value added content is relatively low and the increase has been rather modest. The study further made comparison of foreign value added share in aggregate exports with other emerging economies shows that in terms of degree of integration in global value chains, India lags behind most important emerging economies – Taiwan, Korea, Philippines ,Vietnam, Malaysia, Thailand and China.

Data Descriptions

The calculations for value added in exports are based on the World Input-Output Database that provides the values of input-output transactions among 56 industries for 28 EU countries and 15 other major countries in the world for the period from 2000 to 2014. The data is expressed in millions of dollars. The first and last year of this database has been used for the purpose of analysis i.e. 2000 and 2014. For both the years, 43 countries and 56 industries of the world input-output table have been aggregated into 6 countries, one region and 'rest of the world' input-output table. These 6 countries are China (CHN), India (IND), Japan (JPN), Korea (KOR), Taiwan (TWN) and the United States (US) and one region namely, European Union (EU) and Rest of the World (ROW). The WIOD is valuable because it is sooner is comprehensive as it covers all global trade and all the sectors in each countries national income accounts.

3. Methodology

3.1 Basic Input Output Model

An input output framework with n industries for an economy can be expressed as a system of linear equations by the following expressions:

$$X_i = \sum {}^{n}_{j=1} X_{ij} + Y_i,\ i = 1,2,3\ldots.n \qquad \ldots\ldots\ldots \quad (1)$$

where, X_{ij} is the output of sector i consumed by sector j ,to all types of consumption and for final consumption denoted as Y_i. Further the proportion of each input to the output of sector j is denoted by

$$a_{Lij} = X_{ij} / X_j \quad i, j = 1,n \qquad \ldots\ldots\ldots \quad (2)$$

a_{Lij}'s are called input or technical coefficients and give the direct input requirement of the i_{th} sector for producing one unit of output of j_{th} sector excluding the indirect effects involved in production process.

Thus, above mentioned equation (1) can now be formulated with equation (2), as so called Leontief production function Equation (3)

$$X_i = \sum {}^{n}_{j=1} a_{L,ij} X_j + Y_i \quad i=1,n \qquad \ldots\ldots\ldots \quad (3)$$

where, X is endogenous and the column final demand, Y is exogenous. In matrix notation equation (3) can be written as

$X = A_L X + F$ …… (4)

where, A_L is the n x n coefficient matrix consisting of standardized elements of a_{Lij}, obtained by dividing each element of the column of the flow matrix by the total input of the buying sector. This equation is a fundamental equation of the open Leontief model.

Further, equation (4) can be written as:

$X = (I-A_L)^{-1} * Y = BY$ …….. (5)

where, B is the $n \times n$ Leontief Inverse matrix.

Similarly, in case of an international input output table, Leontief inverse matrix B is defined as a matrix for n sectors and m countries. Thus, for 56 sector and 6 countries and 2 destination regions included in the international input output table R, S = CHN, IND, JPN, KOR, TWN, US, EU-28, ROW.

i = 1, 2, 3,……. 56 and for the above case, the Leontief inverse matrix would be of 448 x 448 dimension matrix.

3.2 Value Added in Trade

The Value added in trade is the value added content of exports which tracks the origin of value added, by country and sector, which is embodied in gross exports generally focusing on the foreign element which is the factor that has witnessed important changes due to the proliferation of global value chains. A variant of this indicator, Trade in Value Added decomposes value added, similarly across countries and sectors but according to final demand. Value added measures the domestic and foreign value added content of trade.

Both involve similar calculation techniques but the former is solely concerned with exporting activities whereas the latter considers the origin of value added in GDP. The difference is important because domestic final demand and gross exports might differ significantly.

A three country one sector production and trade system can be written in block matrix form as follows:

$$\begin{pmatrix} X_1 \\ X_2 \\ X_3 \end{pmatrix} = \begin{pmatrix} A_{11} & A_{12} & A_{13} \\ A_{21} & A_{22} & A_{23} \\ A_{31} & A_{32} & A_{33} \end{pmatrix} \begin{pmatrix} X_1 \\ X_2 \\ X_3 \end{pmatrix} + \begin{pmatrix} Y_{11} + Y_{12} + Y_{13} \\ Y_{21} + Y_{22} + Y_{23} \\ Y_{31} + Y_{32} + Y_{33} \end{pmatrix}$$

$$\begin{pmatrix} X_1 \\ X_2 \\ X_3 \end{pmatrix} = \begin{bmatrix} I - A_{11} & -A_{12} & -A_{13} \\ -A_{21} & I - A_{22} & -A_{23} \\ -A_{31} & -A_{32} & I - A_{33} \end{bmatrix}^{-1} \begin{pmatrix} Y_{11} + Y_{12} + Y_{13} \\ Y_{21} + Y_{22} + Y_{13} \\ Y_{31} + Y_{32} + Y_{33} \end{pmatrix} = \begin{pmatrix} B_{11} & B_{12} & B_{13} \\ B_{21} & B_{22} & B_{23} \\ B_{31} & B_{32} & B_{33} \end{pmatrix} \begin{pmatrix} Y_1 \\ Y_2 \\ Y_3 \end{pmatrix}$$

This system can also be rewritten as follows:

$$X = (I - A)^{-1}Y = BY \quad (6)$$

where B stands for Leontief Inverse Matrix $(I - A)^{-1}$

Using this B to create VAS (Value added share) matrix defined as:

$$\mathrm{VAS} = \mathrm{VB} = \begin{pmatrix} V_1B_{11} & V_1B_{12} & V_1B_{13} \\ V_2B_{21} & V_2B_{22} & V_2B_{23} \\ V_3B_{31} & V_3B_{32} & V_3B_{33} \end{pmatrix} (7)$$

Where $V = \begin{pmatrix} V_1 & 0 & 0 \\ 0 & V_2 & 0 \\ 0 & 0 & V_3 \end{pmatrix}$ is the direct value added coefficient diagonal matrix

Based on this VB foundation, we can calculate VBE

$$\text{If } e = \begin{pmatrix} E_{1*} \\ E_{2*} \\ E_{3*} \end{pmatrix}$$

$$\text{diag (e)} = E = \begin{pmatrix} E_{1*} & 0 & 0 \\ 0 & E_{2*} & 0 \\ 0 & 0 & E_{3*} \end{pmatrix}$$

$$\mathrm{VBE} = \begin{pmatrix} V_1B_{11}E_{1*} & V_1B_{12}E_{2*} & V_1B_{13}E_{3*} \\ V_2B_{21}E_{1*} & V_2B_{22}E_{2*} & V_2B_{23}E_{3*} \\ V_3B_{31}E_{1*} & V_3B_{31}E_{2*} & V_3B_{33}E_{3*} \end{pmatrix} \quad \text{…….. (8)}$$

Where $E_r^* = A_{rs}X + Y_{rs.}$ From equation 8 the following is obtained:

- Diagonal elements of the matrix gives domestic value added in total exports.
- Sum of the off diagonal elements along the column provides the foreign value added in exports of country 1.
- Sum of the off diagonal elements along the row provides indirect value added which is a country's value added embodied as intermediate inputs in third countries gross exports.

3.3 Trade in Value Added

Trade in value added measures how much of value added of a particular country is contained in the consumption of another country. Johnson and Noguera (2012) framework became the foundation for Trade in Value Added method (TIVA).

A three country one sector production and trade system can be written in block matrix form as follows:

$$\begin{pmatrix} X_1 \\ X_2 \\ X_3 \end{pmatrix} = \begin{pmatrix} A_{11} & A_{12} & A_{13} \\ A_{21} & A_{22} & A_{23} \\ A_{31} & A_{32} & A_{33} \end{pmatrix} \begin{pmatrix} X_1 \\ X_2 \\ X_3 \end{pmatrix} + \begin{pmatrix} Y_{11} + Y_{12} + Y_{13} \\ Y_{21} + Y_{22} + Y_{23} \\ Y_{31} + Y_{32} + Y_{33} \end{pmatrix}$$

$$\begin{pmatrix} X_1 \\ X_2 \\ X_3 \end{pmatrix} = \begin{bmatrix} I - A_{11} & -A_{12} & -A_{13} \\ -A_{21} & I - A_{22} & -A_{23} \\ -A_{31} & -A_{32} & I - A_{33} \end{bmatrix}^{-1} \begin{pmatrix} Y_{11} + Y_{12} + Y_{13} \\ Y_{21} + Y_{22} + Y_{13} \\ Y_{31} + Y_{32} + Y_{33} \end{pmatrix} = \begin{pmatrix} B_{11} & B_{12} & B_{13} \\ B_{21} & B_{22} & B_{23} \\ B_{31} & B_{32} & B_{33} \end{pmatrix} \begin{pmatrix} Y_1 \\ Y_2 \\ Y_3 \end{pmatrix}$$

This system can also be succinctly expressed as follows:

$$X = (I - A)^{-1} Y = BY \tag{9}$$

Where B stands for Leontief Inverse Matrix $(I - A)^{-1}$

Using this B to create VAS (Value added share) matrix defined as:

$$\text{VAS} = \text{VB} = \begin{pmatrix} V_1 B_{11} & V_1 B_{12} & V_1 B_{13} \\ V_2 B_{21} & V_2 B_{22} & V_2 B_{23} \\ V_3 B_{31} & V_3 B_{32} & V_3 B_{33} \end{pmatrix} \tag{10}$$

Where $V = \begin{pmatrix} V_1 & 0 & 0 \\ 0 & V_2 & 0 \\ 0 & 0 & V_3 \end{pmatrix}$ is the direct value added coefficient diagonal matrix

Based on this VB foundation, we can calculate VBY

If $y = \begin{pmatrix} Y_{1*} \\ Y_{2*} \\ Y_{3*} \end{pmatrix}$

$$\text{diag}(y) = Y = \begin{pmatrix} Y_{1*} & 0 & 0 \\ 0 & Y_{2*} & 0 \\ 0 & 0 & Y_{3*} \end{pmatrix}$$

$$\text{VBY} = \begin{pmatrix} V_1 B_{11} Y_{1*} & V_1 B_{12} Y_{2*} & V_1 B_{13} Y_{3*} \\ V_2 B_{21} Y_{1*} & V_2 B_{22} Y_{2*} & V_2 B_{23} Y_{3*} \\ V_3 B_{31} Y_{1*} & V_3 B_{31} Y_{2*} & V_3 B_{33} Y_{3*} \end{pmatrix}$$

(11)

Where$Y_{r*} = \sum_s Y_{rs}$ export of final goods from country r to the world

From the above VBY matrix, the diagonal terms $V_1B_{11}Y_{1*}$,$V_2B_{22}Y_{2*}$ and $V_3B_{33}Y_{3*}$ are domestic value added in exports. The sum of off-diagonal terms along a column provides foreign value added in gross exports.

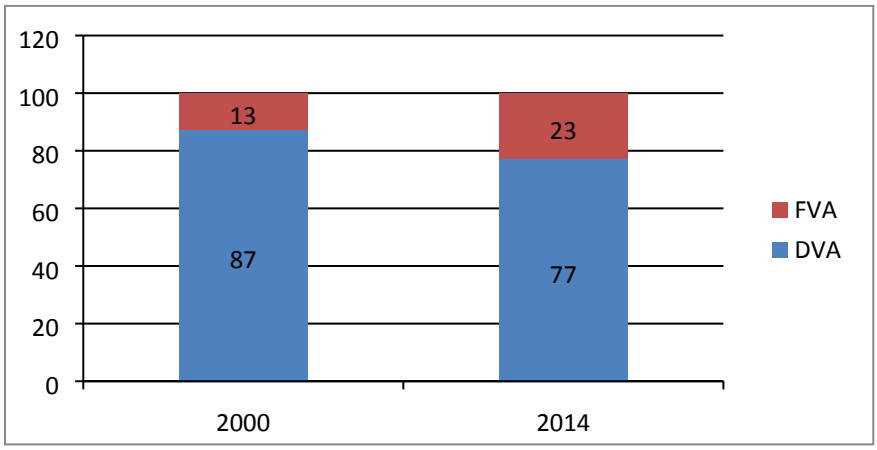
4. Results and Analysis

Based on the methodology described in Section 3 on Vertical Specialization, this section presents the empirical results of the value added content in Indian Exports. In this section the following is examined: (a) domestic value added (DVA) and foreign value added (FVA) in India's Exports at the aggregate level using Value added in Trade Method and Trade in Value Added Method (b) Comparison of Estimates of DVA and FVA in Exports from alternate measures of vertical specialization (c) Domestic and foreign content in India's export at a disaggregate level.

4.1 Domestic and Foreign Value Added share in total exports at aggregate level

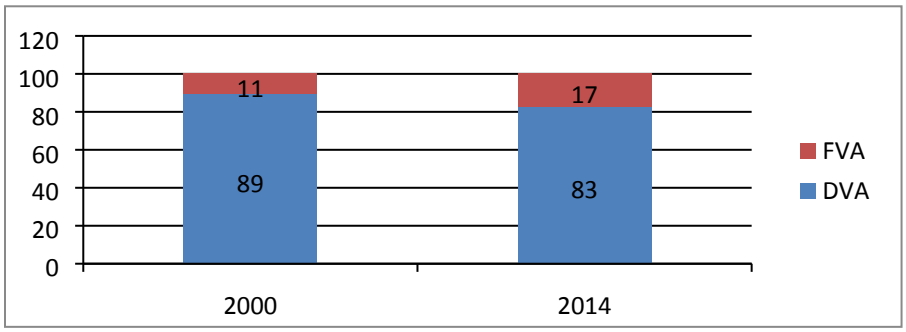
Domestic and foreign value added in aggregate gross exports for India is presented in Figure 1. It is observed from Figure 1 that the domestic value added in total exports has declined from 87 per cent in 2000 to about 77 per cent in 2014. On the other hand, the foreign content in exports increased by about 10 per cent points during the above mentioned period, manifesting a rising trend in fragmentation of production and increasing integration of India into Global Value Chains.

Figure 1: Domestic and Foreign Value Added share in India's Exports (using Value Added in Trade method)



Source: Author's own calculation using WIOD Database,
Note: Values are in per cent

Figure 2: Domestic and Foreign Value Added share in India's Exports (using Trade in Value Added Method)

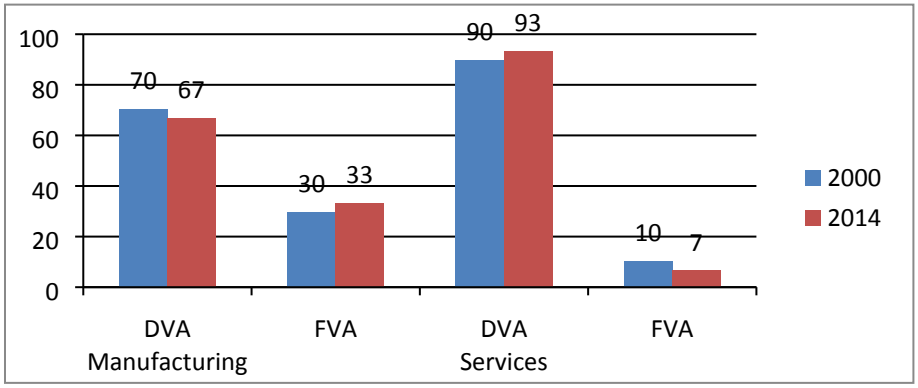


Source: Author's own calculation using WIOD Database, Note: values are in per cent

Trends in share in domestic and foreign value added in exports consisting of only final goods for India is presented in Figure 2. It is observed from Figure 2 that the DVA in total exports consisting of final goods has declined from 89 per cent in 2000 to about 83 per cent in 2014. On the other hand, the foreign content in exports increased by about 6 per cent points during the above mentioned period, manifesting a rising trend in fragmentation of production and increasing integration of India into Global Value Chains.

Thus, whichever set of estimates one chooses from figure 1 and 2, it is evident that there was a downward trend in the DVA content in India's exports, and an increase in import content or FVA share in India's Exports.

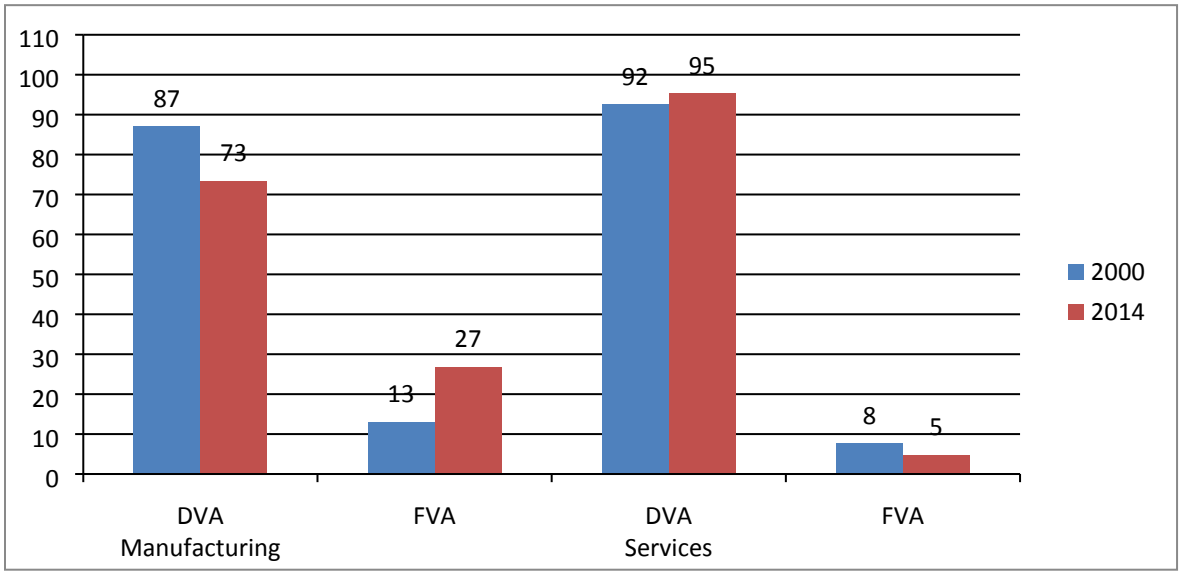
Figure 3: Domestic and foreign value added share in India's Manufacturing and Service exports (using Value Added in Trade Method)



Source: Author's own calculation using WIOD Database, Note: Values are in per cent

The same pattern is observed for manufacturing exports in Table 3. In this case, the increase in foreign value added share is relatively greater; the increase is by about 3 per cent points between 2000 and 2014. While for service exports, the FVA content decreased from 10 per centin 2000 to 7 per cent points in 2014.

Figure 4: Domestic and foreign value added share in India's Manufacturing and Service Exports (Trade in Value Added Method)



Source: Author's own calculation using WIOD Database,
Note: Values are in per cent

The same pattern is observed for manufacturing exports in Table 3. In this case, the increase in FVA share is relatively greater; the increase is by about 14 per cent points between 2000 and 2014. While for service exports, the FVA content decreased from 8 per centin 2000 to 5 per cent points in 2014.

Thus, at level form, it is observed that during the period 2000 and 2014, the FVA share in exports for manufacturing industries is much higher than the foreign value added share in service exports.

4.2 Domestic and Foreign Value Added in India's Exports at Disaggregated Level (Trade in Value Added Method)

A disaggregated level analysis reveals that the extent of fragmentation varies greatly across commodities. It is observed from Table 1 that manufacturing of Coke and refined Petroleum products have maintained the highest percentage of FVA share in exports from 2000 to 2014. The FVA share in exports of manufacturing industries manufacturing Fabricated metals, Machinery and equipments, Basic metals, Transport equipments, Motor vehicles, trailers and semi-trailers, Computer, electronic and optical products and Other transport equipment have been increasing over time indicating increasing fragmentation in the production process of the product. By contrast manufacture of Food products, beverages and tobacco products, Textiles, wearing apparel and leather products and Wood and of products of wood have low FVA share in exports but these have also increased over a period of time and witnessing a fall in domestic value share over the period of study.

Table 1: Domestic and Foreign content in India' Manufacturing Industries Exports at a disaggregated level

WIOD Code	Manufacturing Industries	DVA(%) 2000	DVA(%) 2014	FVA(%) 2000	FVA(%) 2014
C10-C12	Manufacture of food products, beverages and tobacco products	92.7	90.6	7.3	9.4
C13-C15	Manufacture of textiles, wearing apparel and leather products	89.1	86.1	10.9	13.9
C16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	92.7	90.7	7.3	9.3
C17	Manufacture of paper and paper products	83.4	76.0	16.6	24.0
C18	Printing and reproduction of recorded media	81.7	75.9	18.3	24.1
C19	Manufacture of coke and refined petroleum products	58.6	34.8	41.4	65.2
C20	Manufacture of chemicals and chemical products	78.0	68.7	22.0	31.3
C21	Manufacture of basic pharmaceutical products and pharmaceutical preparations	80.2	73.7	19.8	26.3
C22	Manufacture of rubber and plastic products	81.8	71.4	18.2	28.6
C23	Manufacture of other non-metallic mineral products	85.1	73.9	14.9	26.1
C24	Manufacture of basic metals	75.6	58.1	24.4	41.9
C25	Manufacture of fabricated metal products, except machinery and equipment	74.3	65.5	25.7	34.5
C26	Manufacture of computer, electronic and	76.5	73.9	23.5	26.1

	optical products				
C27	Manufacture of electrical equipment	78.1	73.0	21.9	27.0
C28	Manufacture of machinery and equipment n.e.c.	74.9	70.4	25.1	29.6
C29	Manufacture of motor vehicles, trailers and semi-trailers	76.3	69.5	23.7	30.5
C30	Manufacture of other transport equipment	77.5	64.9	22.5	35.1
C31_C32	Manufacture of furniture; other manufacturing	83.5	76.3	16.5	23.7
C33	Repair and installation of machinery and equipment	0.0	0.0	0.0	0.0

Source: Author's own calculation using WIOD Database

Table 2: Domestic and Foreign content in India' Service Industries Exports at a disaggregated level

WIOD Code	Industries	DVA(%) 2000	DVA(%) 2014	FVA(%) 2000	FVA(%) 2014
D35	Electricity, gas, steam and air conditioning supply	86.9	77.9	13.1	22.1
E36	Water collection, treatment and supply	90.8	91.5	9.2	8.5
F	Construction	87.0	82.0	13.0	18.0
G45	Wholesale and retail trade and repair of motor vehicles and motorcycles	97.2	97.2	2.8	2.8
G46	Wholesale trade, except of motor vehicles and motorcycles	97.2	97.2	2.8	2.8
G47	Retail trade, except of motor vehicles and motorcycles	97.3	97.2	2.7	2.8
H49	Land transport and transport via pipelines	86.0	81.5	14.0	18.5
H50	Water transport	91.1	87.1	8.9	12.9
H51	Air transport	87.8	90.0	12.2	10.0
H52	Warehousing and support activities for transportation	92.7	92.6	7.3	7.4
I	Accommodation and food service activities	93.0	91.2	7.0	8.8
J61	Telecommunications	94.9	94.5	5.1	5.5
J62_J63	Computer programming, consultancy and related activities; information service activities	90.5	96.0	9.5	4.0

K64	Financial service activities, except insurance and pension funding	97.2	97.7	2.8	2.3
K65	Insurance, reinsurance and pension funding, except compulsory social security	95.8	95.6	4.2	4.4
L68	Real estate activities	99.5	99.0	0.5	1.0
M69_M70	Legal and accounting activities; activities of head offices; management consultancy activities	95.8	98.0	4.2	2.0
M71	Architectural and engineering activities; technical testing and analysis	78.9	87.4	21.1	12.6
N	Administrative and support service activities	95.7	98.1	4.3	1.9
O84	Public administration and defence; compulsory social security	100.0	100.0	0.0	0.0
P85	Education	98.1	98.2	1.9	1.8
Q	Human health and social work activities	90.5	87.9	9.5	12.1
R_S	Other service activities	93.5	95.9	6.5	4.1

Source: Author's own calculation using WIOD Database

It can be observed from Table 2 that for most of the service industries there have witnessed decline in the FVA share in exports from 2000 to 2014. These industries include, Air transport, Computer programming, consultancy and related activities; information service activities, Financial service activities, Insurance, reinsurance and pension funding, Real estate activities, Architectural and engineering activities; technical testing and analysis among other. Electricity, gas, steam and air conditioning supply has witnessed the highest increase in FVA share in exports over the period under study while the FVA share in exports of Architectural and engineering activities; technical testing and analysis industry has witnessed highest fall.

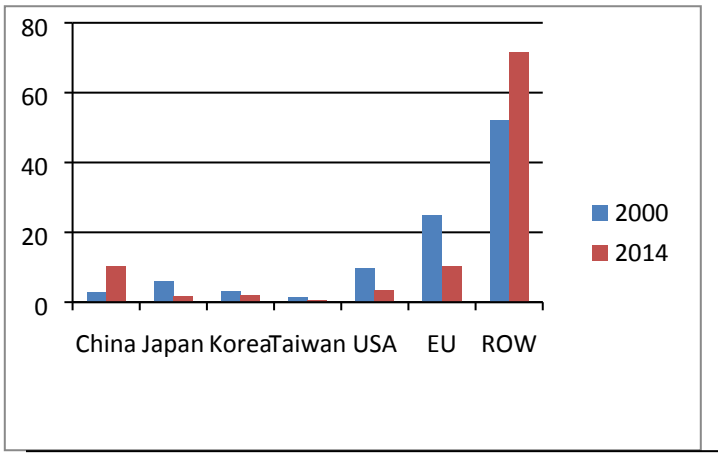
Thus, an increase in FVA share is seen for a majority of industries, indicating the pervasiveness of international fragmentation. Increase in foreign value added in exports was more predominant across manufacturing exports as compared to services exports. The largest increase in import content in exports has occurred in Coke and petroleum products followed by Fabricated metal products, except machinery and equipment

4.3 Foreign Value Added Share of CHN, JPN, KOR, TWN, USA, EU & ROW in India's Exports (Using Trade in Value Added Method)

We are now interested in decomposing domestic and foreign value added in direct Indian exports of final goods on the basis of 5 countries and two destination regions. Trade in value added method has been used to estimate the foreign value added in India's Exports.

Table 3: Foreign Value Added of 5 Countries, One Region and Rest of the world in India's Exports

Countries/ Region	2000(%)	2014 (%)
China	3	10
Japan	6	2
Korea	3	2
Taiwan	1	1
USA	10	3
EU	25	10
ROW	52	72
Total	100	100



Source: Author's calculation using WIOD

Table 3 disaggregates the FVA of other countries in India's Exports. Among the Asian countries, Japan has the highest FVA share in India's Exports for the year 2000. But it is observed that between 2000 and 2014, the share of FVA in India's Exports from China and Rest of the World has increased while witnessing a decline from other Asian countries (Japan, Korea and Taiwan).

Table 4: Foreign Value Added in India's Manufacturing and Service Exports

Countries/ Regions	Manufacturing		Services	
	2000	2014	2000	2014
China	3	13	2	11
Japan	6	2	4	2
Korea	2	2	3	2
Taiwan	1	1	1	1
USA	8	3	14	9
EU	22	13	25	13
ROW	58	67	51	62
Total	100	100	100	100

Source: Author's calculation using WIOD
Note: Values given are in per cent

Table 4 extends the above analysis at a 2 sector level namely manufacturing and services. A similar trend has been observed for Japan having the highest foreign value added share in India Manufacturing and services exports in 2000 among other Asian countries. By contrast in 2014, China has the highest foreign value added share in manufacturing and service exports of India. What is important to note here is that the foreign value added by Japan and China have been relatively higher for manufacturing than service exports between 2000 and 2014. In case of USA and EU, the foreign value added shares have declined for both manufacturing and services between 2000 and 2014 but its foreign value added share has remained relatively high for services than manufacturing for both the years.

Table 5: Foreign Value Added in India's Manufacturing Exports (2000)

WIOD Code	Manufacturing Industries	CHN	JPN	KOR	TWN	USA	EU	ROW	Total
C19	Coke and Refined Petroleum Products	1	2	0	0	2	12	82	100
C20	Chemicals and chemical products	3	6	2	1	9	20	58	100
C21	Basic pharmaceutical products and pharmaceutical preparations	4	6	3	1	10	22	54	100
C22	Rubber and plastic products	4	7	3	1	9	22	53	100
C23	Other non-metallic mineral products	2	5	2	1	6	19	66	100
C24	Basic metals	2	6	2	1	4	22	64	100
C25	Fabricated Metal Products, except Machinery and Equipment	2	8	2	1	4	27	55	100
C26	Computer, Electronic and Optical Products	4	11	4	3	2	30	45	100
C27	Electrical Equipment	3	10	3	1	1	30	52	100
C28	Machinery and Equipment n.e.c.	2	9	2	1	7	32	46	100
C29	Motor Vehicles, Trailers and semi-trailers	2	15	3	1	4	31	43	100
C30	Other transport equipment	2	8	2	1	5	41	40	100

Source: Author's own calculation from WIOD
Note: Values given are in per cent

Table 5 and Table 6 present results for the foreign value added share of 5 countries and 2 destination regions in India's Exports of manufacturing industries for the year 2000 and 2014. The Tables include only those manufacturing industries that have witnessed more than 25 per cent point increase in foreign value added share between 2000 and 2014 as observed from table 1.Results from table 5 and 6 reveal that between 2000 and 2014 the foreign value added share of

China and USA has increased in all the 12 manufacturing industries. By contrast, Japan and EU foreign value added share in all 12 manufacturing industries have decreased. It is observed that

WIOD Code	Manufacturing Industries	CHN	JPN	KOR	TWN	USA	EU	ROW	Total
C19	Coke and Refined Petroleum Products	3	1	0	0	2	5	89	100
C20	Chemicals and chemical products	15	2	3	1	5	10	64	100
C21	Basic pharmaceutical products and pharmaceutical preparations	17	2	3	1	6	11	59	100
C22	Rubber and plastic products	18	3	3	1	6	12	57	100
C23	Other non-metallic mineral products	7	1	1	0	3	8	79	100
C24	Basic metals	8	2	2	0	3	8	78	100
C25	Fabricated Metal Products, except Machinery and Equipment	13	3	3	1	3	12	66	100
C26	Computer, Electronic and Optical Products	27	5	7	2	-4	15	48	100
C27	Electrical Equipment	18	4	4	1	-1	14	60	100
C28	Machinery and Equipment n.e.c.	16	3	3	1	3	16	58	100
C29	Motor Vehicles, Trailers and semi-trailers	19	5	5	1	1	17	52	100
C30	Other transport equipment	19	3	2	1	4	25	46	100

Coke and Refined Petroleum Products and Basic metals have the highest and second highest foreign value added share between 2000 and 2014 while the FVA share was highest by EU in both the industries in 2000.

Table 6: Foreign Value Added in India's Manufacturing Exports (2014)

Source: Author's own calculation from WIOD
Note: Values given are in per cent

In 2014, the FVA by EU in Coke and Refined Petroleum Products and Basic metals declines from 12 per cent to 5 per cent and 22 per cent to 8 per cent respectively while the FVA of ROW Coke and Refined Petroleum Products and Basic metals has increased from 82 per cent to 89 percent and 64 per cent to 78 per cent respectively.

Table 7: Foreign Value Added in India's Service Exports (2000)

WIOD Code	Service Industries	CHN	JPN	KOR	TWN	USA	EU	ROW	Total
D35	Electricity, gas, steam and air conditioning supply	2	5	1	1	1	20	70	100
F	Construction	2	7	2	1	8	25	56	100
H49	Land transport and transport via pipelines	2	5	2	1	9	23	58	100
H50	Water transport	2	6	2	1	9	35	45	100
M71	Architectural and engineering activities; technical testing and analysis	1	3	4	1	26	31	34	100
Q	Human health and social work activities	4	6	3	1	9	21	56	100

Source: Author's own calculation from WIOD
Note: Values given are in per cent

Table 7 and Table 8 present results for the foreign value added share of 5 countries and 2 destination regions in India's Exports of six service industries. The Tables include only those service industries that have witnessed 10 per cent point or more increase in foreign value added share between 2000 and 2014 as observed from Table 2.

Table 8: Foreign Value Added in India's Service Exports (2014)

WIOD Code	Service Industries	CHN	JPN	KOR	TWN	USA	EU	ROW	Total
D35	Electricity, gas, steam and air conditioning supply	7	1	1	0	0	7	83	100
F	Construction	11	2	2	1	3	11	69	100
H49	Land transport and transport via pipelines	9	2	2	1	4	11	72	100
H50	Water transport	18	2	2	1	5	22	50	100
M71	Architectural and engineering activities; technical testing and	11	2	4	1	11	16	56	100

	analysis								
Q	Human health and social work activities	17	2	4	1	6	11	59	100

Source: Author's own calculation from WIOD
Note: Values given are in per cent

In 2000, among the Asian countries, Japan has the highest foreign value added share in exports of all the service industries with highest share in Water Transport and Human health and social work activities. The foreign value added share of all the Asian countries (Japan, Taiwan, and Korea) range 10 per cent to 14 per cent. Whereas, USA has the highest FVA share in Architectural and engineering activities; technical testing and analysis industry. In 2014, the foreign value added share of China has shown an upward trend for all the six service industries. By contrast for Japan and USA has witnessed fall in foreign value added share all the six service industry. The foreign value added share by Taiwan has consistently remained same from 200 to 2014 for all the six service industry.

5. **Conclusion:**

The increased foreign value added share in county's exports has caused a generalized decline in domestic value added share in exports. This phenomenon has been studied for India in this paper using World Input Output Database (WIOD). First for India's exports, the foreign value added share in gross exports and final demand exports has increased from 13 per cent to 23 per cent and 11 per cent to 17 per cent respectively from 2000 to 2014. The rise in the foreign value added share has been relatively greater for manufacturing exports from about 13 per cent in 2000 to about 27 per cent in 2014. In service exports, by contrast, the foreign value added share is relatively low and the decrease has been rather modest. In the above mentioned period, the foreign value added share in service exports decreased from about 8 per cent in 2000 to about 5 percent in 2014.

Similarly at an individual industry level, the decline in domestic value added share is associated with a simultaneous increase in foreign valued added share for majority of the industries, indicating pervasiveness of international fragmentation. Between the time period 2000 and 2014, the largest increase in foreign value added share for manufacturing industries is observed for Coke and refined petroleum products(from 41.4 per cent to 65.2per cent) followed by Basic metals(24.4 per cent to 41.9 per cent). By contrast, for industries like Food products, beverages and tobacco products Textiles, wearing apparel and leather products, Wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials there has been only a small increase in the FVA. In case of service industries, the largest increase in foreign value added share is observed for Electricity, gas, steam and air conditioning supply (13.1 per cent to 22.1 per cent) followed by Land Transport (14 per cent to 18.5 per cent) and Construction (13.5 per cent to 18 per cent).

The analysis of FVA share of China, Japan, Korea, Taiwan ,USA and ROW in India's Exports reveals that the FVA of China has increased in all manufacturing and service industries in the time period 2000 to 2014. By contrast, the Japan that had highest foreign value added share in most of the industries in 2000, its share has fallen in 2014. In case of Taiwan and Korea, the foreign value added shares in all the industries have remained same.

Our results showed that China's position in the value chain of India increased between 2000 and 2014. Though the Indian Government has taken some important policy decisions to increase investment in key manufacturing industries but there is an urgent need to undertake robust policy reforms that will reduce trade barriers, improve infrastructure and promote investment that in turn contribute to increased participation of Indian in global supply chains.

References:

- Timmer, M. P., Dietzenbacher, E., Los, B., Stehrer, R. and de Vries, G. J. (2015), "An Illustrated User Guide to the World Input–Output Database: the Case of Global Automotive Production", Review of International Economics, 23: 575–605

- Goldar, B., Das, D.K., Sengupta, S. and Das, P.C. (2017), Estimating domestic value added and Foreign content in India's Export, Indian Council for research in International Economic Relations. Available at http://icrier.org/pdf/Working_Paper_332.pdf

- Banga (2015), Measuring Value in Global Value Chains, CWS/WP/200/ 8, Centre for WTO Studies, Indian Institute of Foreign Trade. Available at http://wtocentre.iift.ac.in/workingpaper/Measuring%20Value%20in%20Global%20Value%20Chains%20CWS%20WP%20Final.pdf

- Banga, R. (2014), "Trade Facilitation and 'Hollowing-out of Indian Manufacturing", Economic and Political Weekly, 49 (4): 57-63.

- Johnson, R. and G. Noguera (2012), "Accounting for intermediates: Production sharing and trade in value added", *Journal of International Economics*, 86(2): 224–236.

- Koopman, R., Wang, Z., Wei, S., (2008) "How much of Chinese Exports is Really Made in China? Assessing Domestic value-added when processing trade is pervasive" NBER Working paper, No. 14109.

- Koopman, R., Z. Wang and S.-J. Wei (2014), Estimating Domestic Content in Exports When Processing Trade is Pervasive", Journal of Development Economics, 99(1):178-89

- Koopman, R., Z. Wang and S.-J. Wei (2012), "Tracing value added and double counting in gross exports", *American Economic Review,* 104(2): 459–494

- Hummels, D, J. Ishii and K.-M. Yi, (2001), "The nature and growth of vertical specialization in world trade", *Journal of International Economics*, 54 (1): 75-96.

- Amador, Joao and Cabral, Sonia, 'Vertical Specialization in Portuguese International Trade' available at http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.605.6875&rep=rep1&type=pdf

- Chen, X., L. Cheng, K.C. Fung and L.J. Lau (2004). The estimation of Domestic Value added and Employment Induced by exports: An application to Chinese Exports to United States, Stanford University

- Dean, J. M., Fung, K. and Wang, Z. (2007), "Measuring the vertical specialization in Chinese trade", *Office of Economics Working Paper*, 2007-01-A, U.S. International Trade Commission.