Paper to be presented at the 23rd International Input-Output Conference in Mexico City **Structural Change in External Economic Linkages of India**

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**Abstract**

There has been a considerable rise in production networks of trade since 1990s. While the 1990s saw the growth of regional production networks, since 2000 there has been a rise in the involvement of Asian countries in the regional and global production networks. The objective of this study is to examine the changes in external linkages of India with the growth of production networks in Asia. In particular, we use the following methodologies, Rasmussen (1957) index to look at the external backward linkages and the TIVA (Trade in Value Added) method to measure value added in Indian imports disaggregated by country of origin as well as the net trade in value added balance of India with its main trading partners. The results show that there has been a significant increase in the importance of China as a supplier of manufacturing goods to India especially in key manufacturing industries like electronics, transport and machinery industries. The presence of foreign value added in Indian imports from China has increased. The share of Japan`s value added in Indian imports from China decreased while the share of US and rest of the world increased. Our analysis also found that India has a large trade deficit with US in value added terms even though in gross trade terms India has a trade surplus with US. With China, India has a trade deficit in both gross and value added terms. With US India’s trade in value added terms was highest in the services sector and with China, it was highest in secondary sector.

Keywords: Input-Output Analysis, External Backward Linkages, Value Added in Trade, Trade in Value Added

**1. Background**

**1.1. Rise in trade through Production Networks:**

Origins of international production networks have been traced to activities of Multinational Corporations (MNCs) from United States. However, until the 1980s the nature of this trade was mainly a north- north trade between North America and European nations. Overtime these firms began to explore opportunities in North South trade in the neighbouring countries of Latin and South America. Later these MNCs began to look towards East Asia and South East Asia. Consequently there was a rapid increase in production networks in East Asia by middle of 1990s facilitated by the favourable investment and trade policies of these countries.

The reason for the existence of production network trade is best explained by the theory of fragmentation of a firm. The pioneer attempt to explain this theory was made by Jones and Keirzkowski (1990). His idea is presented through a schematic illustration as shown in Figure 1. Figure 1 shows the case of a firm before and after fragmentation. The upper part shows the case before fragmentation. This figure consists of a big rectangle which is divided into smaller rectangles and squares. Assuming the big rectangles represents a firm that produces a single product. The smaller squares and rectangles are production blocs (PB). “Production blocs represent the different kinds of tasks that go into producing that product”. Each bloc can have different characteristics; it can be purely capital intensive, labor intensive or a mix of both. Under some circumstances, it is economical for the firm to separate these production blocs and locate them elsewhere in different host countries.

The lower part of the figure shows the case of a firm after fragmentation. “Each production block is now separated and linked to each other through arrows which are called service links (SL)”. Firms will chose to fragment their production process into production blocs if it is technically feasible and economically profitable. Technical feasibility refers to the technical separability of the production bloc from the main production process. Economic profitability means the separation of production blocks is more profitable than when in a single integrated production process framework. This happens because of two reasons. Either when there is a high efficiency of production costs due to the location advantages of the host country to which the production bloc is moved or when the service link costs incurred in connecting remotely located production blocs are small. These service link costs depend not only on trade barrier and transport cost but also on various coordination costs.

Thus, fragmentation involves the breakup of the production process into fragments of tasks that produce different kinds of intermediate goods which when joined together result in the production of the final good. Many intermediate goods can go into the making of a final good. Moreover, each intermediate good can further be used in the production of other intermediate goods. This creates an interconnected network of production extending across different countries.

**1.2. India in the Production Networks:**

India gained its independence from the British in 1947. From 1947 for nearly four decades until 1991, it pursued an inward oriented socialist style development policy with little reliance on external trade. However, the lacklustre growth in those decades combined with a balance of payment crisis in 1991, motivated India to initiate trade liberalization reforms from 1991. The new economic reforms were geared towards deregulating the industrial sector and integrating the Indian economy with the rest of the world. Following the economic reforms of 1991, Indian economy has enjoyed steady growth over the last two decades. From the infamous Hindu growth rate of 3% in the middle of 1980s, India grew at the rate of 7% to 8% in the first decade of the 21st Century. It now is one of the fastest growing economies in Asia.

Even though India is one of the fastest growing economies of Asia, there is little research that examines the nature of its trade interactions in the production networks of Asia and the world. Furthermore, while there is a lot of research that investigates the linkages between upstream countries like Japan or United States with China; there is barely any literature that examines the interactions among emerging countries like India and China. Understanding India- China trade relation in these production networks is especially important given the importance of China as a supplier of goods. Several studies like Dean et al (2008), Baldwin and Gonzalez (2013), Johnson (2014), Koopman et al (2008, 2010, 2012, 2014), Strehrer (2012), Kuboniwa ( 2014) and Inomata (2013) have confirmed the significant increase in China`s supply of intermediate and final goods to the world. This is particularly true for goods that involve parts and components.

In view of the above background, of increase in trade through production networks and the lack of research on India’s trade interactions in these networks, in this paper we set out to examine the following questions: What changes can be seen in the external linkages of India between 1995 and 2011? What can be said about its external linkages with China? Furthermore, what can be said about the value added content of Indian imports? We examine these questions by comparing our results from the analysis of World Input-Output (IO) Tables for the year 1995 and 2011.

The remainder of this paper is organized as follows; Section 2 gives a description of the database used. Section 3 lays down the methodology. Section 4 presents the results of the analysis and discusses the results. Finally, Section 5 concludes and identifies scope for future research.

**2. Data Description**

The World Input-Output Database provides the values of input-output transactions among 35 industries for 27 EU countries and 13 other major countries in the world for the period from 1995 to 2011.The data is expressed in millions of dollars. [Exchange rates are used to convert national values into US$](http://www.wiod.org/protected3/data/update_sep12/EXR_WIOD_Sep12.xlsx).

We select the first and last year of this database i.e. 1995 and 2011. The objective of this was to compare the change in trade structure between two time periods. Moreover for each year, we aggregated the 40 countries and 35 industries of the world input-output table into 7 countries plus `rest of the world` input-output table. These 7 countries are China (CHN), Germany (DEU), India (IND), Japan (JPN), Korea (KOR), Taiwan (TWN) and the United States (US). All the other countries were grouped into the rest of the world. The reason for selecting these 6 countries is because several studies have identified these countries as the most active players of global value chain in the past decade. Furthermore, our data analysis shows that together these 6 countries account for almost 50%- 60% of total direct and indirect imports into India for almost all industries.

**3. Methodology**

**3.1. External Backward Linkages**

Linkage analysis using the international input-output table is a very effective tool to look at the degree of inter-dependence among different industries as well as among different countries. The foundation of input-output analysis lies in the calculation of the Leontief inverse. For the national input-output table the Leontief inverse shows the direct and indirect effects of a certain final demand that occurred in an industrial sector on other industrial sectors.

For a national economy with *n* sectors and different final demands from each sector, the supply and demand equation can be written as follows:

$$X=AX+F$$

Where $AX$ is the *n × n* intermediate demand matrix

$F$ is the *n* × *1* final demand matrix

And X is the *n* ×*1* output matrix

It can also be rewritten as follows,

$$X=(I-A)^{-1}Y$$

$$X=BY$$

Where B is the *n* × *n* Leontief Inverse matrix

Similarly, in the case of an international input output table, the Leontief inverse matrix B can be defined as a matrix for *n* sectors and *m* countries. Using this matrix B we can calculate the total backward linkages of a country expressed as follows:

$b\_{\*j}=\sum\_{i}^{n}b\_{ij}$

(1)

Where $b\_{\*j}$ is the total backward linkage of country m

$b\_{ij}$ is the $ij^{th}$ element of the Leontief inverse matrix

$n $is the number of sectors

For a case of m countries and n sectors, we can use this formula to disaggregate domestic backward linkages from external backward linkages. The external backward linkages can further be disaggregated based on country.

**3.2 Trade in Value Added (TIVA)**

The phenomenon of fragmentation is termed as vertical specialization of trade in literature. As for the method used to quantify this vertical specialization, Hummels et al (2001) made the pioneer attempt at quantifying it; however his index of vertical specialization included restrictive assumptions like only one country exports intermediate goods which were not very applicable in the real world. His research was extended by more extensive researches like Johnson and Noguera (2012) and Koopman et al. (2010, 2012, and 2014). Both these methods included in their framework different possibilities of exports and imports among countries. Johnson and Noguera (2012) framework became the foundation for Trade in Value Added method (TIVA). In this paper we use the Johnson and Noguera (2012) to look at the following:

a. Value Added in Imports of India

b. Net Trade in Value Added of India

 **3.2. a) Value Added in Imports of India**

Johnson and Noguera (2012) extended on the work of Hummels et al. (2001) to quantify the value added in the gross exports of a country.

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

$$\left(\begin{matrix}\begin{matrix}X\_{1}\\X\_{2}\end{matrix}\\X\_{3}\end{matrix}\right)=\left(\begin{matrix}A\_{11}&A\_{12}&A\_{13}\\A\_{21}&A\_{22}&A\_{23}\\A\_{31}&A\_{32}&A\_{33}\end{matrix}\right)\left(\begin{matrix}\begin{matrix}X\_{1}\\X\_{2}\end{matrix}\\X\_{3}\end{matrix}\right)+\left(\begin{matrix}\begin{matrix}Y\_{11}+Y\_{12}+ Y\_{13}\\Y\_{21}+Y\_{22}+Y\_{23}\end{matrix}\\Y\_{31}+Y\_{32}+Y\_{33}\end{matrix}\right)$$

$$\left(\begin{matrix}\begin{matrix}X\_{1}\\X\_{2}\end{matrix}\\X\_{3}\end{matrix}\right)=\left[\begin{matrix}I-A\_{11}&-A\_{12}&-A\_{13}\\-A\_{21}&I-A\_{22}&-A\_{23}\\-A\_{31}&-A\_{32}&I-A\_{33}\end{matrix}\right]^{-1}\left(\begin{matrix}\begin{matrix}Y\_{11}+Y\_{12}+ Y\_{13}\\Y\_{21}+Y\_{22}+Y\_{13}\end{matrix}\\Y\_{31}+Y\_{32}+Y\_{33}\end{matrix}\right)= \left(\begin{matrix}B\_{11}&B\_{12}&B\_{13}\\B\_{21}&B\_{22}&B\_{23}\\B\_{31}&B\_{32}&B\_{33}\end{matrix}\right)\left(\begin{matrix}\begin{matrix}Y\_{1}\\Y\_{2}\end{matrix}\\Y\_{3}\end{matrix}\right)$$

This system can also be succinctly expressed as follows:

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

 (2)

Where B stands for Leontief Inverse Matrix (I – A)-1

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

$$VAS=VB=\left(\begin{matrix}V\_{1}B\_{11}&V\_{1}B\_{12}&V\_{1}B\_{13}\\V\_{2}B\_{21}&V\_{2}B\_{22}&V\_{2}B\_{23}\\V\_{3}B\_{31}&V\_{3}B\_{32}&V\_{3}B\_{33}\end{matrix}\right)$$

(3)

Where V= $\left(\begin{matrix}V\_{1}&0&0\\0&V\_{2}&0\\0&0&V\_{3}\end{matrix}\right)$　is the direct value added coefficient diagonal matrix

Based on this VB foundation, we can calculate VBY

$$If y=\left(\begin{matrix}Y\_{1\*}\\Y\_{2\*}\\Y\_{3\*}\end{matrix}\right)$$

$$ diag \left(y\right)= Y=\left(\begin{matrix}Y\_{1\*}&0&0\\0&Y\_{2\*}&0\\0&0&Y\_{3\*}\end{matrix}\right)$$

$$VBY=\left(\begin{matrix}V\_{1}B\_{11}Y\_{1\*}&V\_{1}B\_{12}Y\_{2\*}&V\_{1}B\_{13}Y\_{3\*}\\V\_{2}B\_{21}Y\_{1\*}&V\_{2}B\_{22}Y\_{2\*}&V\_{2}B\_{23}Y\_{3\*}\\V\_{3}B\_{31}Y\_{1\*}&V\_{3}B\_{31}Y\_{2\*}&V\_{3}B\_{33}Y\_{3\*}\end{matrix}\right)$$

 (4)

Where$ Y\_{r\*}=\sum\_{s}^{}Y\_{rs}$ export of final goods from country r to the world

From the above VBY matrix, we can see two sequences; the diagonal terms $V\_{1}B\_{11}Y\_{1\*},V\_{2}B\_{22}Y\_{2\*} and V\_{3}B\_{33}Y\_{3\*}$ are domestic value added in exports. The sum of off-diagonal terms along a column provides foreign value added in gross exports. For instance, sum of $V\_{2}B\_{21}E\_{1\*} and V\_{3}B\_{31}E\_{1\*} $is foreign value added in exports of country 1. The sum of off- diagonal elements along a row provides indirect value added (IV) which is a country`s value added embodied as intermediate inputs in third countries` gross exports.

***Modification to Johnson and Noguera (2012) method for our analysis:[[1]](#footnote-1)***

In this paper, we interested in decomposing domestic and foreign value added in direct Indian imports of final goods from 7 countries plus rest of the world. Therefore, the Johnson and Noguera (2012) method can be modified as follows:

For country 1 to 8 in the order CHN, DEU, IND, JPN, KOR, TWN, US, ROW,
 $Y\_{r\*}$ in VBY matrix in equation (4) stands for Indian imports of final goods from each country. The vector of Indian imports from each country can be written as:

$$y^{\*}=\left(\begin{matrix}Y\_{13}\\Y\_{23}\\\begin{matrix}0\\Y\_{43}\\\begin{matrix}Y\_{53}\\Y\_{63}\\\begin{matrix}Y\_{73}\\Y\_{83}\end{matrix}\end{matrix}\end{matrix}\end{matrix}\right)$$

Therefore in our analysis, the original VBY is modified as follows:

$$VBY^{\*}=VB\* diag(y^{\*})$$

(5)

The diagonal elements give domestic value added of that country imported by India. The off diagonal elements give foreign value added that enters India via that country.

**3.2. b) Net Trade in Value Added**

We can use the original Johnson and Noguera (2012) of equation (4), to calculate the net trade in value added by using the following formula:

$$Net Trade in Value Added(TIVA)= VBY^{'}-VBY$$

(6)

Where$VBY$’ is the transpose of $VBY$

Based on the theoretical foundation mentioned in 3.1, 3.2a, and 3.2b, we conduct our empirical analysis for three categories of WIOD industry classification[[2]](#footnote-2):

1. Three sectors (Primary, Secondary and Services): Primary (Industry 1 to 2) Secondary (Industry 3 to 16), Services (Industry 17 to 35).
2. Five sectors (Primary 1, Primary 2, Secondary 1, Secondary 2 and Services): Primary 1 (Industry 1), Primary 2 (Industry 2), Secondary 1(Industry 3 to 11), Secondary 2(Industry 12 to 16), and Services (Industry 17 to 35).
3. From 35 industry classification we select the most networked manufacturing industries. .i.e. Industry 12(Basic Metals and Fabricated Metal), Industry 13(Machinery, Nec), Industry 14 (Electrical and Optical Equipment), Industry 15 (Transport Equipment), Industry 16 (Manufacturing, Nec; Recycling).

In the next section, we summarize the results of our analysis for the methodology described in section 3.

**4. Results**

**4.1. External Backward Linkages**

In this section, we examine the change in the share of India`s external backward linkages with China, Germany, Japan, Korea, Taiwan, US and the rest of the world between the period 1995 and 2011.

1. 3 Sector Case:

Table 1 presents the aggregate backward linkages of India for 3 sectors for 1995 and 2011. The share of Domestic Backward Linkage (DBL) decreased in all the 3 sectors. This decrease was most evident in Secondary sector. Conversely, the share of External Backward Linkage (EBL) increased in all sectors and this increase was most evident in Secondary sector. Figure 2 shows the external backward linkages disaggregated based on country of origin. It can be seen that US was the main supplier to India in both 1995 and 2011. However, by 2011 the share of China increased in all sectors.

1. 5 Sector Case:

For this case, the primary and secondary sectors are broken down into two parts. The reason for doing this is because disaggregating industries gives a clearer picture. The results are presented in Table 2. Between 1995 and 2011, the total backward linkages decreased for primary 1 and primary 2, however for secondary 1, secondary 2 and services, the total backward linkages increased. For both secondary 1 and secondary 2, domestic backward linkages decreased while external backward linkages increased considerably. Within the secondary industries classification, the increase in the EBL of secondary 2 industries between 1995 and 2011 is striking. Table 3 shows the external backward linkages of Secondary 1 and Secondary 2 industries disaggregated based on country of origin for 5 sector case. We can see that the increase in EBL in Secondary 2 in 2011 was mainly due to increase in linkages with China, US and ROW.

1. 35 Sector Case:

Table 4 and Figure 4 summarize the result of the external backward linkages of India based on country of origin for four industry classifications of Secondary 2 group, for 1995. Similarly Table 5 and Figure 5 present the result of external backward linkages for India for the year 2011. Between 1995 and 2011, the external backward linkages increased significantly in all 4 industry categories. The increase was most in industry 16. A disaggregation of industries by country of origin as presented in Figure 4 and Figure 5 shows that US, ROW and China were the main countries that accounted for most of the increase in linkages between 1995 and 2011. In 1995, India`s backward linkages were the highest with US. US accounted for almost 40% of India`s total external backward linkages in industry category 12 to 16. Germany and Japan followed in the second place. Together these three countries, accounted for 50% of India`s total direct and indirect intermediate imports from the world. In 2011, India`s backward linkages were still highest with US. However, the share of Japan and Germany in India`s external linkages decreased compared to that of 1995. On the other hand, China`s share in India`s total external backward linkages grew in almost all the industries, to take the second position in India`s total external backward linkages.

Based on the above analysis, we can summarize as follows: China`s position as a supplier to India increased significantly during the period under consideration. The increase was most significant for Secondary 2 industry classification. Within the Secondary 2 classification, industry 16 (Manufacturing, nec and recycling) accounted for most of the increase.

**4.2. Value Added in Imports of India**

In the previous section, we saw a significant increase in Indian backward linkages with China. In this section, we are interested in seeing how much of those Indian imports from China are really made in China. We separate the domestic value added and foreign value added in Indian final demand imports using the methodology mentioned in Section 3. To get a better picture we compare our results for the case of China and United States.

There are two steps in our analysis, we first calculate the share of domestic value added (DVA) and foreign value added (FVA) in Indian imports between the period 1995 and 2011. Next, we disaggregate total foreign value added content of Indian imports based on country of origin.

1. 3 Sector Case:

Table 6 presents the domestic and foreign value added in Indian imports from China and US. Between 1995 and 2011, the share of FVA in imports of India increased in the case of both countries. However, the share of FVA in imports of India from those countries was much higher in the case of China especially in the case of Secondary industries. Table 7 disaggregates the FVA of other countries in Indian imports from China and US. If we look at the disaggregated results for China, we find that between 1995 and 2011, the share of Asian countries (Japan, Korea and Taiwan) in Indian imports from China decreased. On the other hand, the share of US and ROW increased. In the case of Indian imports from US, the share of Chinese value added increased while the share of Japan decreased.

1. 5 Sector Case:

Table 8 extends the above analysis at a more disaggregated 5 sector level. From table 8, for both 1995 and 2011, the share of Japan is higher in Secondary 2 compared to Secondary 1. This is true in the case of both US and China. Nevertheless, the share of Japanese value added decreased in the case of Indian imports from both US and China.

1. 35 Sector Case:

The share of DVA and FVA in Indian imports from China in 1995 is shown in Table 9. FVA was between 20% and 30% for all industries under consideration. Table 10 further decomposes the FVA in Chinese exports to India based on country of origin. It can be seen that the share of US in the FVA content of Indian imports from China was highest amounting to around 30% to 40%. The share of all the Asian countries (Japan, Taiwan, and Korea) was around 25%. Table 11 shows the results for 4 industries, Industry 12, 13, 14 and 16. We can see that the share of FVA increased in all industries and was around 30% to 40%. The only exception was Industry 16 (Manufacturing, Nec; Recycling) where FVA remained at 21%. Table 12 shows that the share of US in FVA content of Indian imports from China was the highest and increased slightly. The share of rest of the world also increased compared to 1995. On the other hand, the share of value added of Japan, Taiwan, and Korea in Chinese exports to India decreased compared to 1995.

**4.3. Net Trade in Value Added**

Table 13a) and Table 13b) compares the value added trade balance and gross trade balance for India -China and India-United States respectively. The gross trade balance is the difference between gross exports and imports, taken from IMF, Direction of Trade Statistics. Table 13 part a) shows that in 1995 and 2011, India had a trade deficit with China in gross trade terms as well as in value added terms. Table 13 part b) shows that in gross terms India had a trade surplus with United States in both years; however in value added terms it had a large net trade in value added deficit. Table 14a) and b) disaggregate the net trade in value added based on 5 industry classifications for the year 2011. We can see from Table 14 part a) that with China, India’s net value added trade deficit is highest in Secondary 2 industries and from Table 14 part b) we can see that with the United States, it is highest in the service industries.

To summarize, based on the results of section 4.1 and 4.2, we can conclude that between 1995 and 2011 there was a clear structural change in external linkages of India. The results show that the external backward linkages of India were highest with US followed by Germany and Japan in 1995. However, this changed overtime and by 2011, China`s position in the value chain of India increased to take the second place after US. The total FVA in Indian imports from China also increased between the two periods. Much of the FVA in Indian imports from China came from the US. Between 1995 and 2011, the position of Japan and other Asian countries in FVA in Indian imports from China decreased. Finally, we found that with China, India has a trade deficit in both gross terms and value added terms however with United States; India has a trade surplus in gross terms but a large net trade in value added deficit. The net trade in value added deficit of India was highest with China in Secondary 2 industries and with the United States it was highest in services industries.

**6. Conclusion**

This research brought into light several interesting findings about the external linkages of India. In the following part, we will discuss and interpret the main finding of this paper:

Our results showed that China’s position in the value chain of India increased between 1995 and 2011. This result was expected given that China’s position as supplier of manufacturing goods rose during that period. We could also see from our analysis that there was an increase in FVA in Indian imports from China. This confirms the results of previous literature like like Dean et al (2008), Baldwin and Gonzalez (2013), Johnson (2014), Koopman et al (2008, 2010, 2012, 2014), Strehrer (2012), Kuboniwa ( 2014) and Inomata (2013) who using international input- output tables have shown that Chinese exports contain imported components. With respect to foreign value added in Chinese exports, our results pointed to one novel finding. Previous literature have underlined the importance of China as a downstream country where intermediate inputs from upstream countries like Japan and the four dragons( Singapore, Hongkong, Taiwan, Korea) are processed for export to various destinations especially US and Western EU. Following from those results, we expected that the foreign value added in Indian imports from China will have high foreign value added of Asian countries like Japan and four dragons. However, our analysis showed that there is a high value added of United States in Indian imports from China amounting to as much as 50% of total foreign value added in Indian imports from China. The pattern remains the same across primary, secondary and service industry classifications. This shows that China’s procurement pattern for India is different from the usual pattern in Asia. This finding also points to the extent to which India is linked to United States. Not only does India have direct linkages to United States (as seen from the results of External Backward Linkages) but also it has indirect linkages as almost half of the foreign value added in Indian imports from China is from the United States. Furthermore, our result from net trade in value added showed that India has a large net trade in value added deficit with United States even though in gross terms it has a surplus. This result further reconfirms India’s ‘double dependence’ (direct and indirect) on United States.

One limitation of this study is that we could not see the linkages between India and the ASEAN countries because of limitation of data. It would be interesting to examine this when data is available. Furthermore, another promising way in which this research can be extended is by analysing the factor content of trade in the external linkages of India. The SEA (Socio Economic Accounts) database of WIOD that provides details on labour used to produce a unit of output will be very helpful for this study.

To conclude, the result of this thesis provides useful insights into the changes in India`s external linkages with the growth of production networks. In future, the availability of new and richer datasets will provide useful ways to extend this research.

**Figures and Tables**

Figure 1 The Fragmentation Theory: Production Blocs and Service Links



Source: Jones and Keirzkowski (1990) as depicted in Ando and Kimura (2011)

Figure 2 Disaggregated External Backward Linkages of India (3 sectors)

Figure 3 External Backward Linkages of India 1995

Figure 4 External Backward Linkages of India 2011

Table 1 Aggregated External Backward Linkages of India (3 sectors)

|  |  |  |  |
| --- | --- | --- | --- |
| 1995 | Primary  | Secondary  | Services  |
| DBL  | 1.38  | 2.26  | 1.61  |
| EBL  | 0.10  | 0.46  | 0.21  |
| Total  | 1.48  | 2.72  | 1.81  |

|  |  |  |  |
| --- | --- | --- | --- |
| 2011  | Primary  | Secondary  | Services  |
| DBL  | 1.33  | 2.06  | 1.54  |
| EBL  | 0.12  | 0.88  | 0.36  |
| Total  | 1.45  | 2.94  | 1.90  |

Table 2 Aggregated External Backward Linkages of India (5 sectors)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 1995  | Primary 1  | Primary 2  | Secondary 1  | Secondary 2  | Services  |
| DBL  | 1.37  | 1.44  | 2.19  | 2.39  | 1.61  |
| EBL  | 0.09  | 0.19  | 0.44  | 0.49  | 0.21  |
| Total  | 1.46  | 1.64  | 2.62  | 2.88  | 1.81  |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 2011  | Primary 1  | Primary 2  | Secondary 1  | Secondary 2  | Services  |
| DBL  | 1.33  | 1.34  | 2.09  | 2.02  | 1.54  |
| EBL  | 0.10  | 0.18  | 0.72  | 1.09  | 0.36  |
| Total  | 1.43  | 1.52  | 2.80  | 3.10  | 1.90  |

Table 3 Disaggregated External Backward Linkages of India (5 sectors)

|  |  |  |
| --- | --- | --- |
| 1995  | Secondary 1  | Secondary 2  |
| CHN  | 0.01  | 0.01  |
| DEU  | 0.02  | 0.03  |
| IND  | 0.00  | 0.00  |
| JAP  | 0.02  | 0.04  |
| KOR  | 0.01  | 0.01  |
| TWN  | 0.00  | 0.00  |
| USA  | 0.18  | 0.20  |
| RoW  | 0.19  | 0.20  |
| Sum  | 0.44  | 0.49  |

|  |  |  |
| --- | --- | --- |
| 2011  | Secondary 1  | Secondary 2  |
| CHN  | 0.08  | 0.19  |
| DEU  | 0.01  | 0.03  |
| IND  | 0.00  | 0.00  |
| JAP  | 0.01  | 0.03  |
| KOR  | 0.01  | 0.02  |
| TWN  | 0.00  | 0.01  |
| USA  | 0.27  | 0.39  |
| RoW  | 0.32  | 0.41  |
| Sum  | 0.72  | 1.09  |

Table 4 External Backward Linkage for India 1995

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 12.Basic and Fabricated Metal  | 13.Machinery, Nec  | 14.Electrical & Optical Equipment  | 15.Transport Equipment  | 16.Manufacturing, Nec; Recycling  |
| CHN  | 0.01  | 0.01  | 0.01  | 0.01  | 0.01  |
| DEU  | 0.03  | 0.04  | 0.03  | 0.03  | 0.03  |
| JPN  | 0.03  | 0.04  | 0.03  | 0.04  | 0.03  |
| KOR  | 0.01  | 0.01  | 0.01  | 0.01  | 0.01  |
| TWN  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  |
| US  | 0.19  | 0.21  | 0.15  | 0.17  | 0.22  |
| ROW  | 0.21  | 0.22  | 0.16  | 0.18  | 0.23  |
| EBL Sum  | 0.47  | 0.53  | 0.39  | 0.46  | 0.54  |

Table 5 External Backward Linkage for India 2011

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **2011**  | 12.Basic and Fabricated Metal  | 13.Machinery, Nec  | 14.Electrical & Optical Equipment  | 15.Transport Equipment  | 16.Manufacturing, Nec; Recycling  |
| CHN  | 0.08  | 0.10  | 0.13  | 0.12  | 0.46  |
| DEU  | 0.02  | 0.03  | 0.02  | 0.03  | 0.05  |
| JPN  | 0.03  | 0.02  | 0.02  | 0.03  | 0.03  |
| KOR  | 0.02  | 0.02  | 0.02  | 0.02  | 0.02  |
| TWN  | 0.01  | 0.01  | 0.01  | 0.01  | 0.01  |
| US  | 0.32  | 0.29  | 0.27  | 0.28  | 0.74  |
| ROW  | 0.38  | 0.32  | 0.30  | 0.31  | 0.74  |
| EBL Sum  | 0.85  | 0.79  | 0.78  | 0.79  | 2.06  |

|  |  |  |
| --- | --- | --- |
| **China 2011**  | DVA  | FVA  |
| Primary  | 84%  | 16%  |
| Secondary  | 68%  | 32%  |
| Services  | 82%  | 18%  |

Table 6 Foreign Value Added in Indian Imports (3 sectors)

|  |  |  |
| --- | --- | --- |
| **China 1995**  | DVA  | FVA  |
|  Primary  | 90%  | 10%  |
| Secondary  | 79%  | 21%  |
| Services  | 86%  | 14%  |

|  |  |  |
| --- | --- | --- |
| **US 1995**  | DVA  | FVA  |
|  Primary  | 93%  | 7%  |
| Secondary  | 88%  | 12%  |
|  Services  | 96%  | 4%  |

|  |  |  |
| --- | --- | --- |
| **US 2011**  | DVA  | FVA  |
| Primary  | 88%  | 12%  |
| Secondary  | 81%  | 19%  |
| Services  | 94%  | 6%  |

Table 7 Foreign Value Added in Indian Imports (3 sectors) Disaggregated

|  |  |  |  |
| --- | --- | --- | --- |
| **China 1995**  | Primary  | Secondary  | Services  |
|  DEU  | 3%  | 3%  | 3%  |
| IND  | 0%  | 0%  | 0%  |
| JAP  | 13%  | 15%  | 15%  |
| KOR  | 6%  | 6%  | 5%  |
| TWN  | 5%  | 6%  | 5%  |
| USA  | 40%  | 38%  | 38%  |
| ROW  | 34%  | 32%  | 32%  |
|  | 100%  | 100%  | 100%  |

|  |  |  |  |
| --- | --- | --- | --- |
| **China 2011**  | Primary  | Secondary  | Services  |
| DEU  | 3%  | 3%  | 4%  |
| IND  | 1%  | 1%  | 1%  |
| JAP  | 5%  | 6%  | 6%  |
| KOR  | 3%  | 3%  | 4%  |
| TWN  | 2%  | 3%  | 2%  |
| USA  | 42%  | 42%  | 42%  |
| ROW  | 43%  | 42%  | 41%  |
|  | 100%  | 100%  | 100%  |

Table 7 (Continued)

|  |  |  |  |
| --- | --- | --- | --- |
| **US 1995**  | Primary  | Secondary  | Services  |
|  CHN  | 2%  | 3%  | 3%  |
| DEU  | 6%  | 6%  | 6%  |
|  IND  | 1%  | 1%  | 1%  |
| JAP  | 11%  | 14%  | 12%  |
| KOR  | 2%  | 3%  | 3%  |
| TWN  | 2%  | 3%  | 3%  |
| ROW  | 75%  | 70%  | 72%  |
|  | 100%  | 100%  | 100%  |

|  |  |  |  |
| --- | --- | --- | --- |
| **US 2011**  | Primary  | Secondary  | Services  |
| CHN  | 9%  | 11%  | 15%  |
| DEU  | 4%  | 4%  | 5%  |
| IND  | 3%  | 2%  | 3%  |
| JAP  | 4%  | 4%  | 5%  |
| KOR  | 1%  | 2%  | 2%  |
| TWN  | 1%  | 1%  | 2%  |
| ROW  | 77%  | 75%  | 69%  |
|  | 100%  | 100%  | 100%  |

Table 8 Foreign Value Added in Indian Imports (5 sectors) Disaggregated

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **China 1995**  | Primary 1  | Primary 2  | Secondary 1  | Secondary 2  | Services  |
| DEU  | 3%  | 3%  | 3%  | 4%  | 3%  |
| IND  | 0%  | 0%  | 0%  | 0%  | 0%  |
| JAP  | 11%  | 15%  | 12%  | 18%  | 15%  |
| KOR  | 6%  | 5%  | 7%  | 5%  | 5%  |
| TWN  | 5%  | 5%  | 6%  | 6%  | 5%  |
| USA  | 41%  | 38%  | 38%  | 37%  | 38%  |
| ROW  | 34%  | 33%  | 34%  | 30%  | 32%  |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **China 2011**  | Primary 1  | Primary 2  | Secondary 1  | Secondary 2  | Services  |
| DEU  | 3%  | 4%  | 2%  | 4%  | 4%  |
| IND  | 1%  | 1%  | 1%  | 1%  | 1%  |
| JAP  | 4%  | 6%  | 4%  | 7%  | 6%  |
| KOR  | 3%  | 3%  | 3%  | 4%  | 4%  |
| TWN  | 2%  | 2%  | 2%  | 4%  | 2%  |
| USA  | 43%  | 41%  | 42%  | 41%  | 42%  |
| ROW  | 44%  | 44%  | 46%  | 40%  | 41%  |

Table 8( Continued)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **US 1995**  | Primary 1  | Primary 2  | Secondary 1  | Secondary 2  | Services  |
| CHN  | 3%  | 2%  | 3%  | 3%  | 3%  |
| DEU  | 6%  | 6%  | 6%  | 7%  | 6%  |
| IND  | 2%  | 1%  | 1%  | 1%  | 1%  |
| JAP  | 9%  | 10%  | 9%  | 19%  | 12%  |
| KOR  | 2%  | 2%  | 2%  | 5%  | 3%  |
| TWN  | 2%  | 2%  | 2%  | 4%  | 3%  |
| ROW  | 76%  | 78%  | 78%  | 62%  | 73%  |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **US 2011**  | Primary 1  | Primary 2  | Secondary 1  | Secondary 2  | Services  |
| CHN  | 9%  | 9%  | 8%  | 17%  | 14%  |
| DEU  | 4%  | 4%  | 3%  | 6%  | 5%  |
| IND  | 4%  | 2%  | 1%  | 2%  | 3%  |
| JAP  | 3%  | 4%  | 3%  | 8%  | 5%  |
| KOR  | 1%  | 1%  | 1%  | 3%  | 2%  |
| TWN  | 1%  | 1%  | 1%  | 2%  | 2%  |
| ROW  | 77%  | 80%  | 83%  | 61%  | 70%  |

|  |
| --- |
| Table 9 Domestic and Foreign Value Added in Indian Imports from China(35 Sectors) (1995) |
|  |  | DVA | FVA | Total Exports |
| Industry 12 | Basic Metals and Fabricated Metal | 79% | 21% | 100% |
| Industry 13 | Machinery, Nec | 80% | 20% | 100% |
| Industry 14 | Electrical and Optical Equipment | 72% | 28% | 100% |
| Industry 15 | Transport Equipment | 79% | 21% | 100% |
| Industry 16 | Manufacturing, Nec; Recycling | 79% | 21% | 100% |

|  |
| --- |
| Table 10 Foreign Value Added in Indian Imports from China (35 Sectors) Disaggregated (1995) |
|  | DEU | IND | JPN | KOR | TWN | USA | ROW | Total  |
| Industry 12 | 3% | 0% | 16% | 4% | 4% | 38% | 34% | 100% |
| Industry 13 | 4% | 0% | 18% | 5% | 5% | 37% | 31% | 100% |
| Industry 14 | 3% | 0% | 19% | 5% | 6% | 38% | 28% | 100% |
| Industry 15 | 5% | 0% | 19% | 5% | 6% | 36% | 29% | 100% |
| Industry 16 | 3% | 0% | 13% | 7% | 6% | 39% | 33% | 100% |

|  |
| --- |
| Table 11 Domestic and Foreign Value Added in Indian Imports from China (35 Sectors) (2011) |
|  | DVA | FVA | Total Exports |
| Industry 9 | 66% | 34% | 100% |
| Industry 12 | 62% | 38% | 100% |
| Industry 13 | 68% | 32% | 100% |
| Industry 14 | 61% | 39% | 100% |
| Industry 15 | 69% | 31% | 100% |
| Industry 16 | 79% | 21% | 100% |

|  |
| --- |
| Table 12 Foreign Value Added in Indian Imports from China (35 Sectors) Disaggregated (2011) |
|  | DEU | IND | JPN | KOR | TWN | USA | ROW | Total Foreign Value Added  |
| Industry 9 | 3% | 1% | 4% | 2% | 2% | 42% | 47% | 100% |
| Industry 12 | 2% | 1% | 4% | 2% | 1% | 42% | 49% | 100% |
| Industry 13 | 5% | 1% | 7% | 3% | 2% | 42% | 40% | 100% |
| Industry 14 | 3% | 1% | 8% | 5% | 6% | 41% | 37% | 100% |
| Industry 15 | 5% | 1% | 9% | 4% | 2% | 40% | 38% | 100% |
| Industry 16 | 3% | 1% | 5% | 3% | 2% | 45% | 42% | 100% |

Table 13 Comparing Gross Trade Balance and Value Added Trade Balance

|  |  |  |
| --- | --- | --- |
| a.India-ChinaUS$ Millions | Gross Trade Balance | TIVA(Value Added TB) |
| 1995 | -529 | -924 |
| 2011 | -36186 | -40771 |
| Method | IMF, DOTS | I-O Analysis |

|  |  |  |
| --- | --- | --- |
| b.India-US US$ Millions | Gross Trade Balance | TIVA(Value Added TB) |
| 1995 | 1961 | -18964 |
| 2011 | 9905 | -158093 |
| Method | IMF, DOTS | I-O Analysis |

Table 14 Value Trade Balance (5 sector case)

|  |  |  |
| --- | --- | --- |
| India-China 2011  | $Million (TIVA)  | Share in Total |
| Primary 1  | -522  | 1%  |
| Primary 2  | -1941  | 5%  |
| Secondary 1  | -10406  | 26%  |
| Secondary 2  | -18886  | 46%  |
| Services  | -9015  | 22%  |
| Total | -40771  | 100%  |

|  |  |  |
| --- | --- | --- |
| India-US 2011  | $Million (TIVA)  | Share in Total |
| Primary 1  | 971  | 1%  |
| Primary 2  | -22903  | 14%  |
| Secondary 1  | -14380  | 9%  |
| Secondary 2  | -26064  | 16%  |
| Services  | -95717  | 61%  |
| Total | -158093  | 100%  |

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**Appendix A: WIOD Industry Classification**

1 Agriculture, Hunting, Forestry and Fishing
2 Mining and Quarrying
3 Food, Beverages and Tobacco
4 Textiles and Textile Products
5 Leather, Leather and Footwear
6 Wood and Products of Wood and Cork
7 Pulp, Paper, Paper , Printing and Publishing
8 Coke, Refined Petroleum and Nuclear Fuel
9 Chemicals and Chemical Products
10 Rubber and Plastics
11 Other Non-Metallic Mineral
12 Basic Metals and Fabricated Metal
13 Machinery, Nec
14 Electrical and Optical Equipment
15 Transport Equipment
16 Manufacturing, Nec; Recycling
17 Electricity, Gas and Water Supply
18 Construction
19 Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel
20 Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles
21 Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods
22 Hotels and Restaurants
23 Inland Transport
24 Water Transport
25 Air Transport
26 Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies
27 Post and Telecommunications
28 Financial Intermediation
29 Real Estate Activities
30 Renting of M&Eq and Other Business Activities
31 Public Admin and Defence; Compulsory Social Security
32 Education
33 Health and Social Work
34 Other Community, Social and Personal Services
35 Private Households with Employed Persons

1. This modification of Koopman method extends on a suggestion of OECD and WTO (2012). According to the report: “Between the pioneering work of Hummels et al. (2001) and these latest studies, the conceptual framework has been enhanced and we now have a full understanding of what constitutes trade in value-added terms. The exercise consists in distinguishing domestic and foreign value-added. But, as previously pointed out, the difficulty is that “domestic value-added” can be found indirectly in imports of foreign inputs (as ‘returned domestic VA’) and when exported to another country can be also indirectly found in exports from third-countries. The field is therefore not only extremely relevant, but also fully mature for its full inclusion in official statistics. The next step in the analysis is to provide a full decomposition of the foreign value-added according to the country of origin of the VA.” ( OECD and WTO, 2011;Pg20) [↑](#footnote-ref-1)
2. Please see the Appendix A for details about industry classification. [↑](#footnote-ref-2)