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## The potential for involving India in regional production networks: Analyzing vertically specialized trade patterns between India and ASEAN

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# **Working Paper 292**

## **The potential for involving India in regional production networks: Analyzing vertically specialized trade patterns between India and ASEAN**

**Meenu Tewari  
C. Veeramani  
Manjeeta Singh**

**January 2015**



## Table of Contents

<b>Abstract and Summary .....</b>	<b>ii</b>
<b>1. Introduction .....</b>	<b>1</b>
1.1 <i>Methodology.....</i>	<i>4</i>
1.2 <i>Organization of the paper.....</i>	<i>5</i>
<b>2. Vertical Specialization and Task Fragmentation in the Trade Literature .....</b>	<b>5</b>
2.1 <i>The Economics of Fragmentation: First Generation Explanations.....</i>	<i>5</i>
2.1.1 <i>Intermediate Inputs and Intra-Industry Trade.....</i>	<i>6</i>
2.1.2 <i>Consequences of Fragmentation.....</i>	<i>7</i>
2.2 <i>Measuring International Fragmentation and Vertical Specialization.....</i>	<i>7</i>
2.3 <i>What Drives Vertical Specialization and Fragmentation in Trade?.....</i>	<i>9</i>
2.4 <i>Vertical Specialization and Industrial Upgrading.....</i>	<i>10</i>
<b>3. Trade Data Analysis: Trends and patters in vertically specialized trade between India and ASEAN .</b>	<b>12</b>
3.1 <i>Data and methods.....</i>	<i>12</i>
3.2 <i>Tracing Trends in India and ASEAN’s Multilateral Network Trade .....</i>	<i>13</i>
3.2.1 <i>Exports: Faster Growth of Network Trade in Capital and Natural Resource Intensive Sectors over Traditional Sectors.....</i>	<i>13</i>
3.2.2 <i>The Top Product Groups in India’s and ASEAN’s Network Exports to the World .....</i>	<i>15</i>
3.2.3 <i>Imports: Deepening Vertical Trade; Parts and Components Imports Grow Faster than Imports of Finished Goods.....</i>	<i>16</i>
3.3 <i>Trends and Patterns of Fragmentation Based Bilateral Trade between India and ASEAN.....</i>	<i>17</i>
3.3.1 <i>Bilateral Exports: Improving Network Trade Shares on Both Sides .....</i>	<i>17</i>
3.3.2 <i>An Analysis of Export Intensities .....</i>	<i>19</i>
3.3.3 <i>Bilateral Imports: High Value, Technology-Intensive Products Dominate India’s Import Basket..</i>	<i>21</i>
3.3.4 <i>An Analysis of Vertical and Horizontal Measures of Bilateral Intra-Industry Trade.....</i>	<i>23</i>
3.3.5 <i>High Quality vs. Low Quality VIIT .....</i>	<i>24</i>
3.3.6 <i>The Skill Composition of India’s Exports .....</i>	<i>25</i>
3.4 <i>Summing Up.....</i>	<i>26</i>
<b>4. View from the field: Firm level analysis.....</b>	<b>29</b>
4.1 <i>Power-sector subsidies, price-pressured end-users and their innovation dampening effects: The challenges of upgrading with a primarily domestic focus .....</i>	<i>30</i>
4.3 <i>Policy Costs: Land Acquisition, Coal-Linkages, Inverted Duty Structure, Taxation and Infrastructure .....</i>	<i>32</i>
4.4 <i>Market Making Role of Standards, and the Domino Effect of Missing Input MarketsTaxation and incentives for investment.....</i>	<i>35</i>
4.5 <i>Upgrading within Global Production Networks .....</i>	<i>37</i>
<b>5. Conclusions .....</b>	<b>41</b>
<b>References:.....</b>	<b>43</b>
<b>Appendix: Tables and Figures.....</b>	<b>49</b>

## Abstract and Summary

At a time when regional production networks have been resurgent, especially in Asia, why has India's integration in regional markets had not been deeper? Using highly disaggregated trade data and an analysis of industry perspectives based on semi-structured interviews with a sample of firms and industry associations relevant to India's trade with ASEAN, the paper found that despite low volumes, vertically specialized trade has been growing between India and ASEAN. Overall, there is significant potential for deepening India's engagement in ASEAN by expanding intermediates exports in the machinery sector, building on its strong

performance in the chemicals sector by expanding the export of higher value specialty chemicals, and in general attempting to move up the value chain in the parts, components and assembled goods exported in the road vehicles and transport equipment product categories and telecommunications and sound recording equipment segments where network exports (assembled end products) are important. There is tremendous underexploited potential for growth in electronics and related equipment categories (HS 85).

Our field level interviews bore out some of these emerging trends and showed that while East Asia and ASEAN are seen as important destinations for Indian exports, deeper integration is affected by three factors: (i) Indian firms' preoccupation with the large domestic market over exports; (ii) the low value addition in Indian manufacturing which translates into low-value component exports and a high degree of reliance on expensive imports; and (iii) a variety of impediments that add to production costs, such as: sub-optimal scales of production in key intermediate sectors, a near total lack of quality inputs (high quality steel, electronics, quality plastics), precision and high quality tooling, the complete absence of the electronics hardware sector (including semiconductor devices), and a lack of serious R&D or skill development. These structural deficits are compounded by policy costs imposed on firms by the disabling lack of reliable power supply, inadequate infrastructure and logistics, high interest rates and land costs, and an unstable policy environment. Although some firms have found innovative ways to cope, the costs are high.

The broader point is that upgrading within regional production networks requires domestic capability formation. In addition to mitigating supply side bottlenecks and behind the border problems, however, this calls for attention to demand side factors and policy inducements that can ratchet up production quality, standards, deepen collaborative and competitive capabilities and generate learning that can create the conditions for upgrading in an institutional context of production sharing.

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**The potential for involving India in regional production networks:  
Analyzing networked production and vertically specialized trade patterns between  
India and ASEAN<sup>1</sup>**

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## 1. Introduction

The rise of value chains and global production networks is a central feature of international trade today. The deepening economic interdependence between globally dispersed firms and workers is reflected in the fragmentation of production and the distribution of value adding activities across global geographies. Consequently trade involves not only an exchange of end products, but of parts and components that go into making them (Feenstra 1998, Gereffi 1994, 1999, Kemeny and Rigby 2010). These patterns of exchange are not easily captured by standard trade models that are based on classical patterns of specialization and comparative advantage. As a result, in recent years, a growing new literature has emerged that focuses on vertically disintegrated trade flows and on intermediates trade to measure the complex ways in which value is added as a product moves along spatially dispersed networks from input stage to distribution (Koopman et. al 2011, Athukorala 2010, Sturgeon and Memedovic 2012, Gereffi et. al, 2013, Hummels et al 2001).

These patterns of trade have major implications for industrial policy, for the ways in which nations compete, create jobs and develop. Recent research shows that the fastest growing economies are those that have a complex mix of specializations centred not only on finished products and entire sectors, but on an ‘unbundled’ set of tasks and capabilities that can feed into multiple sectors and multiple products embedded in national as well as global production regimes (Hidalgo and Hausmann 2008, Rodrik and Hausmann 2003, Kemeny and Rigby 2010, Baldwin 2006, Gereffi 1994, 1999). Many have described this as vertically specialized trade or ‘task trade,’ that is associated with the rise in parts and components (P&C) and intra-industry trade rather than final products alone (Kemeny and Rigby 2010, Jiang and Milberg 2012).

It is widely acknowledged that P&C trade has grown much faster than total manufacturing and has played an important role in the expansion of international trade during the last three decades (Feenstra 1998, Gereffi 2011, Millberg and Scholler 2008, Grossman and Rossi-Hansberg 2011). During 1992/3-2006/7, world manufacturing exports increased three-fold from US\$ 2651 billion to US\$ 8892 billion, while world exports of P&C rose five-fold from US\$ 511 billion to US\$ 2405 billion. This resulted in a substantial increase in the share of P&C in total manufacturing exports from around 19 per cent to 27 per cent during the same period (Athukorala 2010). By 2007, trade in intermediates accounted for nearly 60 per cent of world trade in manufacturing compared to just over 50 per cent in 1990. For services, trade in intermediates stood at nearly 70 per cent in 2007 ((Miroudet et. al 2009, Millberg and Jiang 2012).

Organizationally, trade fragmentation is anchored in production networks and governed by the global value chains that run across them. Although the development of production networks is a global phenomenon, their growth in East Asia and China has been particularly

impressive. The deeply embedded regional trade linkages between partner nations in production networks have enabled the region to maintain a full value sourcing network that has mitigated trade diversion and contributed to regional growth and national industrial development (Medvedev 2012, Liden 1998). In the last two decades East Asia has been one of the fastest growing and dynamic economic regions in the world. Its share in world manufacturing trade increased from about 28 per cent in 1992-93 to 34 per cent in 2006-07 and some economies, such as China, have become leading exporters in the world. A large proportion of East Asian trade in manufactures is intra-regional and this is due largely to the predominance of production networks across the sub-region. It is on account of this factor that the share of intra-regional exports of P&C increased at a rate higher than that of global exports of P&C of the sub-region, from 23.6 to 47.6 per cent during 1992-93 to 2006-07 (Athukorala 2010).

The picture for India is quite different. Until the introduction of economic reforms in 1991-92 India remained outside the mainstream of industrial development in the region. Even after almost two decades of reforms, manufactures constitute only about 15 per cent of GDP and even though India's share in global trade has tripled between 1990 and 2011, it is still less than two per cent and India's share of world trade in manufactures is just one per cent. The experience of East Asia suggests that one of the important reasons for this is the lack of participation by India in regional production networks. In 2006-07, India's share in world exports of P&C was only 0.4 per cent, far less than most other developing economies in East Asia such as China, Philippines, Indonesia, Malaysia, and Thailand. China's early engagement in global production sharing is evident from the fact that parts and components accounted for 31 per cent of China's non-fuel merchandise imports and 15 per cent of its exports soon after it joined the WTO, compared to only 12 and 6 per cent for India respectively during that time (Dimaranan et al. 2004).

This paper uses the lens of Indo-ASEAN trade to investigate why India's participation in regional production networks has not been deeper. What explains the persistent inability of Indian manufacturing to become more regionally embedded? India and ASEAN signed a wide-ranging free-trade agreement in 2009 (AIFTA) creating the potential for a possible opening toward production sharing. But data show that levels of trade, especially in components and assembled goods remain low. An understanding of the dynamics of vertically specialized trade between India and ASEAN can help shed light on the emerging ties between Indian and East Asian production networks. It can also shed light on the implications of these linkages for India's own industrial development trajectory, its goals of industrial job creation and the fostering of backward and forward linkages in production domestically, and within the wider region.

A secondary concern of the paper is the low employment intensity of Indian manufacturing, particularly in light of several rounds of policy reforms that have taken place since 1991-92 and the rapid growth of demand in the domestic market. Some of the standard factors assumed to inhibit the global competitiveness of Indian manufacturing are well known, for example, inadequacy in a wide range of supply side factors such as under-developed physical

infrastructure including power supply and transportation networks, lack of labor flexibility, and a swath of policy deficits such as complexities of internal taxation, lack of availability of developed land for industry, delays in a wide variety of clearances ranging from environmental to customs clearances, an increasingly severe skill deficit in virtually all sectors of manufacturing, unsustainably high interest rates and inadequacies in the availability of finance from commercial banks for SMEs or venture funds for R&D investments. Despite these well-known problems, are there sectors that have been able to break these bottlenecks and enhance global production sharing in their value chains? If so what explains their performance and what are the conditions that set them apart from sectors that have done less well in this regard. In addressing these issues, the paper deals mainly with the ‘behind the border’ situation within India.

### *1.1. Methodology*

The study uses mixed methods to address these questions, involving both quantitative (trade data analysis) and qualitative techniques (21 face to face interviews with firms, policy makers and industry associations). The quantitative analysis identifies the patterns of manufacturing trade between India and ASEAN at multiple levels of disaggregation, and over a ten year period from 2000-2011. It also identifies the product categories where India has the highest levels of vertically specialized trade with ASEAN (as a group) and vice versa. This analysis forms the basis of the interviews that were conducted with purposive sample of firms, industry actors and government officials.

Using these methods we compare bilateral trade patterns to each region’s multilateral patterns of vertically specialized trade and identify five product categories where India has the highest intermediates trade with ASEAN. These include (1) Machinery, Transport Equipment and Scientific Instruments (comprised of HS 84, 85, 87 and 90), (2) Basic Metals and Products (HS 72, 73, 74, 76, and 80), (3) Chemicals (including HS 29, 32, and 38), (4) Plastics and Rubber (HS 39 and 40) and (5) Other (a miscellaneous list of HS groupings). Within these categories we conduct a more detailed analysis at four and six digit HS levels and identify: (a) high performing sectors where vertically specialized trade has experienced high rates of growth during the past decade, (b) depressed/stagnant sectors where growth rates and shares have fallen over the same period, and (c) sectors with high potential for integration where multilateral imports into ASEAN are high, but imports from India are low. The firms we interviewed fall within these three groupings.

In the field, we conducted key informant interviews in each sector with the relevant industry association (e.g., CII, Indian Machine Tool Association, ACMA<sup>4</sup>, CEAMA<sup>5</sup>, IEEMA<sup>6</sup> and so on), followed by interviews with lead manufacturers in the selected sectors and their suppliers where relevant. We also spoke with government officials to get a perspective on industrial policy goals for particular sectors and in response to issues that emerged from interviews with firms and business associations. A total of twenty-one interviews were conducted based on

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<sup>4</sup> Automotive Component Manufacturers Association

<sup>5</sup> Consumer Electronics and Appliance Manufacturers Association

<sup>6</sup> Indian Electrical and Electronics Manufacturers Association



purposive sampling. In addition we reviewed government documents, the business literature and trade statistics provided to us by industry associations. This was supplemented by a review of the literature on the trade fragmentation and production networks, and Indo-ASEAN trade ties and trade agreements.

### *1.2. Organization of the paper*

The rest of the paper is organized as follows. The next section reviews the theoretical and empirical literature on the economics of fragmentation and vertically specialized trade. Section III reports on the trade data analysis we carried out for ASEAN and India's vertically specialized trade at the multilateral level, Section IV focuses on the findings from an analysis of bilateral, inter-regional patterns of vertically specialized trade between India and ASEAN. Section VI discusses the key findings from our field based interviews with Indian firms in five subsectors about the drivers of, and bottlenecks to, regional integration, and Section VII concludes with a brief reflection on the implications of our findings for industrial policy and upgrading.

## **II. Vertical Specialization and Task Fragmentation in the Trade Literature**

Over the past thirty years parts and components trade has risen faster than finished goods trade. This growth in intermediates trade is reflected in the rising import content of exports, or vertical specialization as it is called in the literature (Jiang and Milberg 2012). Rising intermediates trade is indicative of the growing fragmentation of global production, where the production tasks and value adding activities are unbundled and outsourced to geographically dispersed locations and are linked together by global value chains that are driven by lead firms. Because these developments do not fit with standard trade models and their predictions, we begin with a review of the theoretical and empirical literature on trade and vertical specialization to map out the various explanations for global production sharing (network trade), trace its key drivers, and review what the literature says about the implications of fragmentation for industrial upgrading and development.

### *2.1. The Economics of Fragmentation: First Generation Explanations*

Pioneering research in the early 1980s provided the first theoretical explanation for intra-industry trade (Krugman, 1979, 1980; Dixit and Norman, 1980; Lancaster, 1980 and Helpman 1981). This research, collectively known as new trade theory, provided trade models incorporating the elements of product differentiation, economies of scale and imperfect competition. While some of the restrictive assumptions of the traditional trade model were relaxed, the new trade theory still considers 'industry' as the unit of analysis while firms (which are assumed to be symmetric) within each industry produce different varieties of a final consumer good. These models assume horizontal product differentiation – that is, final consumer goods are differentiated by certain attributes (like packaging characteristics, brand etc.) but not by quality. Horizontal IIT (Intra-Industry Trade) is explained by economies of scale in the presence of product differentiation and imperfect competition. Firms in each country would manufacture a subset of the varieties within an industry for meeting home demand and export. At the same time, the varieties that are not

produced within the country are imported to meet domestic demand. This leads to IIT in horizontally differentiated varieties for final consumption. Horizontal models are considered to be of greater relevance for understanding the occurrence of bilateral IIT in consumer goods among developed countries. While vertical product differentiation – that is differentiation of final consumer goods based on quality – explains IIT between countries with clearly different factor endowments (Falvey 1981, Falvey and Kierzkowski 1987, Flam and Helpman 1987, and Shaked and Sutton 1984).

### *2.1.1. Intermediate Inputs and Intra-Industry Trade*

While the horizontal and vertical models help us understand IIT, their focus on final consumer goods implies that these models are not of much use for understanding vertical specialization and production sharing across countries, which occurs at the level of intermediate inputs. Yi (2003) argues that standard models of trade in final goods, including Heckscher-Ohlin (H-O) and IIT models cannot account for how the modest observed declines in trade barriers could have produced the dramatic observed growth in world trade. To explain this increase, Yi formulates a model linking a decline in trade barriers to a magnified decrease in production costs, which in turn leads to a magnified increase in trade flows. Analysis shows that this model can explain at least half of the observed increase in world trade since the 1960s. The model incorporates a dynamic process where technological and organizational innovations make it possible to slice up the production process, while global reductions in tariffs lead to a magnified reduction in the cost of producing inputs and create incentives for locating different stages of production across countries.

With respect to IIT, in contrast to the usual approach of focusing on differentiated consumer goods, Ethier (1979, 1982) advanced a valuable theoretical analysis focussing on differentiated producer goods (i.e., intermediate goods). He focuses on the significance of three important aspects of international commerce: international returns to scale, product differentiation in producer goods and interdependence of world industrial activity. He points out that economies of scale resulting from an increased division of labor depend on the size of the world market rather than the level of production in any one country. The interdependence of world industrial activity implies global dispersion of the distinct production operations in an industry based on the efficiency gains from increased specialization. The analysis produces a model of IIT in intermediate products, wherein the desire for product variety arises as a consequence of larger markets permitting a deeper division of labor. Like other models of horizontal IIT, Ethier's model also predicts that similarities of factor endowments between nations tend to promote IIT. For example, it can theoretically account for the dominant share of intra-OECD trade in parts and components (Yeats, 2001, Hummels et al, 2001).

Fragmentation theory, first proposed by Jones and Kierzkowski (1990) takes the debate a little further. It explains vertical specialization-based trade between countries with *different* factor endowments<sup>7</sup>. According to this theory, comparative advantage based specialization

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<sup>7</sup>Also see Jones and Kierzkowski (2001), Deardorff (2001), Cheng and Kierzkowski (2001), and Kimura and Ando (2005).

carries through to trade in parts and components. Industry fragments in the production chain are located across countries on the basis of comparative advantage determined by the relative factor endowments of countries and factor intensities of the components. Fragmentation theory also highlights the importance of scale economies in component production as well as in the services links that connects the production fragments. If a firm can supply a given component to the competing producers of a given final product, the component producing firm can achieve larger production runs and thus enjoy greater scale economies than is possible if production were fully integrated. Offshore sourcing and production is thus possible. Kimura and Ando (2005) further point to the possibility of a two-way causation and agglomeration -- geographical concentration of production blocks can reduce service link costs while lower service link costs would further attract production blocks. Kimura et al (2007) apply this to East Asia and argue that fragmentation theory is better able to explain the pattern of intra-regional specialization there than the traditional horizontal product differentiation intra industry trade patterns found in places like Europe.

### *2.1.2. Consequences of Fragmentation*

Using the framework of fragmentation theory, a number of papers attempted to analyze the consequences of fragmentation in terms of welfare, income distribution, wages, and employment. Global gains from trade may be enlarged with fragmentation because it allows more finely defined production processes to be allocated across countries more efficiently (Yi, 2003). Arndt (1997, 1998) shows that fragmentation can be trade enhancing and welfare improving. His analysis shows that offshore sourcing in an industry increases employment and wages because of high net job creation – that is, job growth in activities that are still performed at home more than compensate for the jobs lost due to sub-contracting. Jones and Kierzkowski (2001) argue that the welfare effect of fragmentation is generally positive though the adverse terms of trade effect cannot be ruled out. Bhagwati et. al (2004) demonstrate that outsourcing leads to gains from trade and its effect on jobs and wages are not qualitatively different from those of conventional trade in goods. However, these effects depend upon the underlying policy regime. Arndt (2001) shows that the ‘rules of origin’ clause built into the free trade agreements may make it difficult for the member countries to fully exploit the benefits of intra-product specialization<sup>8</sup>. Grossman and Hansberg (2008) introduce the term “task trade” and show that the effect of a decline in the cost of task trade is very similar to that of factor-augmenting technological progress in that it directly boosts the productivity of the factor whose tasks become easier to move offshore.

## **II.2. Measuring International Fragmentation and Vertical Specialization**

It is not easy to quantify the magnitude of cross border production and trade using published trade data. Conventional trade statistics report the gross value of goods at each border

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<sup>8</sup> Athukorala (2011, pp 92-93) points out that rules of origin requirements are presumably more detrimental to network trade than to final-goods trade, “because of the inherent difficulties in defining the product for duty exemption and because of the transaction costs associated with the bureaucratic supervision of the amount of value-added in production coming from various sources. ....The conventional value added criterion is not virtually applicable to this trade because the products involved are low-value-added by their very nature”.

crossing, rather than the net value added between border crossings. Further, multi-country production networks imply that intermediate inputs cross borders several times during the manufacturing process, and trade is recorded (in gross terms) each time this happens. This double (or multiple) counting means that published trade data overstate the domestic (value added) content of exports.

Given this problem with published trade data, analysts have used different approaches to analyze the trends and patterns of fragmentation based trade. First, some studies have used statistics in connection with the use of special OECD tariff provisions that provide for preferential treatment for the re-entry of domestically produced parts and components assembled abroad (Helleiner 1973; Sharpton 1975; USITC 1999; Gorg 2000, Yeats, 2001, Clark, 2010). These records provide information on parts and components exported from source countries and assembled goods received in return. However, these data are limited to OECD countries and to a select range of products.

Much of the trade in intermediates is the result of global vertical production networks and value chains created by multinational firms by locating input processing in foreign affiliates. Therefore, some studies use micro data on back-and-forth intra-firm transactions between headquarters (located in the US, EU or Japan) and their foreign affiliates. Helleiner (1981) was one of the first to study fragmentation from the perspective of transnational corporations and intra-firm trade<sup>9</sup>. This approach, however, does not capture arm's length transactions between unrelated firms and hence underestimates the magnitude of fragmentation. This is a major lacuna given that international outsourcing to external suppliers has increased faster than intra-firm trade in intermediates (Antras and Helpman, 2004).

Third, a large number of studies have used highly disaggregated trade data to separate trade in parts and components from final goods (see for e.g., Yeats, 2001; Ng and Yeats, 2003; Athukorala, 2005; Kimura, 2006; Athukorala and Menon (2010), and Athukorala, 2011). A majority of existing studies have used disaggregated data based on Standard International Trade Classification (SITC Rev 2). The SITC Rev 2 system identifies about 60 product groups, at the lowest (five digit) level, as representing parts and components. The newer harmonised system (HS) of trade classification expands this coverage to 200 product groups as representing parts and components.

Another approach to gauge intra-industry specialization involves the computation of intra-industry trade in intermediate inputs (e.g., Kierzkowski, 2001, Fukao et al, 2003, and Kimura, 2006). The well-known index suggested by Grubel and Lloyd (1975) is generally used to measure the intensity of IIT in an industry. The index of IIT ( $GL_{jt}$ ) in industry  $j$  and year  $t$  in trade of the country under consideration is defined as:

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<sup>9</sup> Other studies that have made use of data on activities of multinational firms include Borga and Zeile (2004), Hanson et. al (2005), Ando and Kimura (2005), and Kimura (2006).

$$GL_{jt} = \frac{(X_{jt} + M_{jt}) - |X_{jt} - M_{jt}|}{(X_{jt} + M_{jt})} \times 100, \quad (1)$$

where:  $X_{jt}$  = value of exports from India or China in industry  $j$  and year  $t$

$M_{jt}$  = value of imports to India or China in industry  $j$  and year  $t$

While  $GL_{jt}$  measures IIT in a specific industry, its trade-weighted average can be used to measure IIT in the aggregate groups of industries and the economy as a whole. Following Abdel-Rahman (1991) and Greenaway et al (1994), some studies disentangle total IIT into its two components – horizontal and vertical – using relative unit values of export and imports. Horizontal IIT (HIIT) was defined as the simultaneous export and import of a product where the ratio of export unit value to import unit value was within a specified range –such as 0.85 to 1.15 or 0.75 to 1.25. When the ratios are outside the specified range, any IIT was considered to be vertical in nature (VIIT).

Finally, in an important development, Hummels et. al (2001) proposed an index of vertical specialization using input-output tables. Recently, Koopman et al (2010) proposed a more comprehensive framework for measuring the foreign value added share of a country's exports taking into account the back-and-forth trade of intermediates across multiple borders. This approach supplements the value added approach to calculating vertical specialization shares by using input output accounts to separately model both the foreign value added share embodied in gross exports and the domestic value added embodied in third countries gross exports (see also De Backer and Miroudot 2012), who have extended and applied this analysis using the recently developed OECD inter-country input output model that covers 56 countries and 37 industries.

### **II.3. What Drives Vertical Specialization and Fragmentation in Trade?**

Many studies note that the major driving forces behind the steadily increasing “task trade” generally include: (i) worldwide reduction of tariff barriers, (ii) spatial interdependence and production sharing by multinational firms, and (iii) expansion of transportation and communication networks. However, few studies exist that econometrically analyze the determinants of vertical specialization and fragmentation based trade. That said, the major findings from some of the existing econometric studies are summarized below.

Using gravity equations, Miroudot et al (2009) analyzes the role of trade costs, bilateral market size, and activities of multinational firms in determining the imports of intermediate inputs in comparison with end products in OECD countries. The analysis shows that imports of intermediate products are more sensitive to trade costs, less attracted by bilateral market size, and are positively associated with the activities of multinational enterprises. Econometric analysis by Athukorala and Menon (2010) reveals that parts and components are less sensitive to changes in relative prices. According to them, this may imply that exchange rate policies may be less effective in achieving balance-of-payments adjustments in countries where component trade is high. Kimura et al (2007) use gravity models to confirm that the

differences in location advantages and service link costs are important in determining the extent of trade at least in machinery parts and components in East Asia.

Hanson et al (2005) use data on affiliates of US multinational companies to find that a one per cent fall in trade costs leads to a two per cent to four per cent increase in the quantity of imported intermediate inputs for further processing. This finding is consistent with the hypothesis that a small change in tariffs may produce large changes in input trade (Yi, 2003). Cross country regression analysis by Pitigala (2008), however, shows that tariffs have become less important for vertical specialization, as many developing countries now administer export-processing zones, duty suspension, and drawback facilities for export-oriented production activities. Pitigala argues that the most important determinants of vertical specialization are access to finance, quality of infrastructure and political stability and governance. Financial access becomes important because the firms supplying intermediate goods need intra-period credit. Producers of final goods may not pay their intermediate goods suppliers before they sell the final good. Political risk becomes particularly important for vertically integrated industries because output disruption in a given location due to political instability can disturb production plans for the entire production chain (2008).

Using data generated from offshore assembly provisions in the US tariff code, Clark (2010) investigates country and industry-level determinants of vertically specialized production and trade between the US and both developed and developing countries. Country level determinants include factor endowment differences between the US and a foreign country, workforce availability, foreign market size, proximity to other countries, trade orientation, exchange rate distortion, and political environment in the host country. He finds that the educational attainment of the workforce exerts a positive effect on vertical specialization with developed countries and a negative effect with developing countries, although the impacts of industry-level determinants (capital-labor ratio, product differentiation, scale economies, tariff rate, technology intensity, import competition etc.) are generally similar for developed and developing country partners.

A diversity of factors, then, drive vertically specialized trade -- primarily interdependence of production structures, falling trade barriers and policies that affect cost and speed. But at the end of the day, what are the implications of this trade fragmentation for development, employment and upgrading? An emerging body of literature has begun to explore this question as we briefly examine next.

#### **II.4. Vertical Specialization and Industrial Upgrading**

In a series of new papers Milberg and his colleagues (2008, 2009 2012, 2013) have tried to connect vertical specialization with industrial upgrading. The literature associates economic development with upgrading in global value chains, understood as a progressive shifting of production and employment from lower to higher value added activities in a chain (Gereffi 2009, Humphrey and Schmitz 2002, and Pietrobelli and Rabelotti). Upgrading is defined as being mainly of four types: process, product, functional and chain upgrading (Humphrey and

Schmitz 2002). Process upgrading involves gains stemming from improved efficiencies and innovations in the production process. Product upgrading involves moving to higher value products in a particular value chain and it may or may not involve product development abilities. Functional upgrading refers to the development of capacities where a producer can take control over more and more value added functions such as design, product development, branding and input sourcing. Chain upgrading refers to moving out of a lower value chain to a new product area that generates higher value added (such as shifting from labor intensive sectors to more technology and knowledge intensive sectors) (Humphrey and Schmitz 2002 and Jiang and Milberg 2012).

Jiang and Milberg (2012) define vertical specialization as the import content of exports (supplemented by a wider input-down specific notion they measure by their import content of export expansion ratio, ICEER). Upgrading is defined as the capturing domestically a higher proportion of export value, through backward linkages or other forms of domestic capacity development. In their framework, which is still in preliminary stages of development, a decline in vertical specialization is interpreted as an indicator of industrial upgrading, where upgrading in a sector means relying less on imported inputs. A reduction of foreign inputs in a country's exports would mean an increase in domestic value added. These could come from two sources: (i) more value is added domestically through backward linkages or higher input demand, (ii) and/or a larger segment of the value adding process is performed domestically, via localization effects (Jiang and Milberg 2012).

Since economic development today requires participation in global production networks, and vertical specialization is bound to rise as a country develops, Milberg et. al., (2013) argue that upgrading requires understanding how a country's cross-sectoral pattern of vertical specialization changes over time, since vertical specialization would be shrinking for some sectors and rising for others. Applying this model to five countries, USA, China, Brazil, India and South Africa, the authors find vertical specialization follows an U shaped curve as an economy upgrades. They show that vertical specialization increases at first, as a country enters into global production in a new sector, gradually diminishes as domestic value-adding capabilities are consolidated in that sector, and then rises again as it shifts to a new segment or specializes in a few core high value segments.

This is a promising new line of research, but remains a work in progress and many cautions apply which even the authors point out: It is important to distinguish the effects on value added as one studies localization outcomes. E.g., mere substitution of domestic inputs for foreign inputs has no effect on value added, nor does vertical upgrading say anything about technical change in a sector, nor does it capture the fact that as an economy produces higher value added products locally, it might increase its reliance on higher value added component imports initially (Jiang and Milberg 2012).

Ongoing research (Milberg, Jiang and Gereffi 2013) in this area however makes clear that the industrial policy implications of vertically specialized trade in world of globalized production are different from simply import protection under Import Substitution Industrialization (ISI)

or export expansion as under Export Oriented Industrialization (EOI). Today, when “exports might contain high import content, and some imports might contain high export content,” policies will need to “manage” global value chains and a country’s participation in production networks rather than focus on blanket localization or export promotion. It involves managing the participation of domestic and manufacturing firms in varied global networks with an eye to developing the capabilities of moving progressively into higher value production but in engagement with foreign buyers, suppliers and networks of production.

With these cautions in mind, we turn to the empirical analysis of our case and examine the patterns of vertically specialized trade between India and ASEAN.

### **III. Trade Data Analysis: Trends and patterns in vertically specialized trade between India and ASEAN**

The emergence of ASEAN-India Free Trade Area (AIFTA) in 2010 opened up new possibilities for India and ASEAN to engage in production sharing activities. As part of AIFTA, India and ASEAN agreed to reduce or eliminate import tariffs for about 80 per cent of mutually traded goods. Based on an empirical analysis of current trends and patterns in fragmentation-based trade between India and ASEAN for the period 2000-2011,<sup>10</sup> we assess the potential for and obstacles to greater cross border production sharing between the two regional economies.

#### *3.1. Data and methods*

As many scholars have pointed out in the literature, decoupling parts and components trade and process trade from final goods trade is difficult. The standard method of measuring vertically specialized trade (in parts, components and processes) is to calculate the import content of a country’s exports (Millberg and Jiang 2013). In addition one can identify product categories dominated by assembled goods, where final goods trade is largely precluded. Athukorala (2011) provides a good example of this approach. To segregate parts and components trade, he focuses on specific product categories in which network trade (production sharing, or the import content of exports) is heavily concentrated.<sup>11</sup> “Network products” generally do not contain any end products that are produced from start to finish in a given country.

Following this approach we based our analysis on a disaggregated dataset we built using highly disaggregated trade data obtained from the UN Comtrade database that we concorded with BEC classification to identify trade in manufactured parts and components. To build this dataset, we first downloaded trade data for India and ASEAN at the 6-digit level of the Harmonised System (HS) of trade classification using the WITS software. This yielded a total

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<sup>10</sup> Within the ASEAN group, only the largest six countries — Indonesia, Malaysia, the Philippines, Thailand, Singapore, and Vietnam—are covered in the analysis. Other smaller economies— Brunei, Cambodia, Laos, and Myanmar — are excluded due to the paucity of data.

<sup>11</sup> He identifies seven product categories: office machines and automatic data processing machines (SITC 75), telecommunication and sound recording equipment (SITC 76), electrical machinery (SITC 77), road vehicles (SITC 78), professional and scientific equipment (SITC 87), and photographic apparatus (SITC 88) (Athukorala 2011).



of 5017 product codes at the 6-digit HS level (see Table 1). This was concorded with the Standard International Trade Classification (SITC) revision 3 to identify and extract all the manufacturing product codes. Consistent with standard practice, this gave us a list of manufacturing codes at the 6-digit HS level that corresponded with SITC 5 (chemicals), SITC 6 (manufactured materials), SITC 7 (machinery and transport equipment) and SITC 8 (miscellaneous manufactured articles). We next identified and separated out the codes related to parts and components within manufacturing using the BEC system of classification (Broad Economic Categories system)<sup>12</sup>. Within the manufacturing group this generated 4185 HS product codes at the 6-digit level, of which more than one half (2518) were parts and components (see Table 1).

Finally we separated these into ‘network products which comprises of ‘assembled end products’ and ‘parts and components.’ Within our dataset 576 codes at the 6-digit HS level belonged to the group of ‘network products,’ of which 241 are parts and components. Thus, the value of ‘assembly trade’ was approximated as the difference between the total value of trade in network products and the value of trade in parts and components within this category.<sup>13</sup> Using this database, we conducted our analysis of parts and components trade between India and ASEAN relative to their trade in parts and components with the world as an indication of the trends in vertically specialized trade between the two regions.

In addition to categorizing trade patterns, our goal was also to identify the products in which India’s trade in parts and components with ASEAN was high (and vice-versa), and products which were important to ASEAN but where India’s participation was not prominent yet, but potential for greater trade existed. We used a sample of both these sets of products to conduct interviews with firms as well as with government officials to understand why vertically specialized trade was high in some components and not in others, and what could be done to increase India’s participation in East Asian production networks, as well as what the government’s thinking was in the development of more deeply engaged networked trade relations.

### ***III.2. Tracing Trends in India and ASEAN’s Multilateral Network Trade***

#### ***3.2.1. Exports: Faster Growth of Network Trade in Capital and Natural Resource Intensive Sectors over Traditional Sectors***

Table 2 reports the average annual growth rates of multilateral exports and imports (in current US\$) for different groups of products from ASEAN and India for the period 2000-2011. Compared to ASEAN, India recorded a faster growth rate of both exports and imports across all product groups during the last one decade, but from a much smaller base. During 2000-

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<sup>12</sup> Parts and components consist of all 6-digit HS codes belonging to the following five BEC codes: Processed industrial supplies not elsewhere specified (BEC 22); Parts and accessories of capital goods, except transport equipment (BEC 42); Parts and accessories of transport equipment (BEC 53); Other processed fuels and lubricants (BEC 322); and Processed food and beverages mainly for industry (BEC 121).

<sup>13</sup> Therefore, at the 6-digit HS level, the total number of assembled products within the category of ‘network products’ is 335 (= 576 – 241). As Atukhoralala warned, it is not easy to distinguish between trade in assembled goods and trade in parts and components. But the breadth of the data give us a broad idea of the pattern of trade fragmentation.

2011, India's total manufactured exports registered a growth rate of about 17.7 per cent per annum, or nearly double that of ASEAN's growth rate in manufactured exports (8.7 per cent per annum). However, the base effect is evidenced by the stark difference in the respective volumes of export. The value of aggregate manufactured exports from ASEAN at the start of the period (for the year 2000) stood at US\$ 332 billion, which was nearly ten times as high as that of India's manufactured exports (that is, US\$ 35 billion for the year 2000). This difference has begun to narrow over the last decade. By 2011, India's manufacturing exports stood at US\$ 195 billion compared to the corresponding value of ASEAN of US\$ 705 billion.

In keeping with East Asia's well-integrated regional trade networks, ASEAN member states have consistently recorded much higher export and import shares of parts and components trade than India. For India, the share of parts and components in total manufactured exports was about 58 per cent in 2000 and remained fairly constant in 2011 as the growth rate of both end products and parts and components exports was comparable. For ASEAN, however, manufactured parts and components recorded a much higher growth rate of exports (9.3 per cent) than finished products (7.7 per cent). Thus, the components share in total manufactured exports from ASEAN increased from 60.5 per cent to 65.4 per cent between 2000 and 2011 (see Figure 1 and 2).

India's exports of 'network products,'<sup>14</sup> in particular, recorded significantly higher growth rate (24.8 per cent per year) than aggregate manufacturing (17.7 per cent per year). Therefore, the share of network products in India's total manufactured products steadily increased and doubled over the past decade from about 6 per cent in 2000 to 12 per cent in 2011. For ASEAN, network products constitute the bulk of its exports, accounting for a hefty 65 per cent of manufactured exports in 2000. Given this heavy base value, it is not surprising that ASEAN'S exports of network products grew slower (5.7 per cent per year) than that of other manufactured products (8.7 per cent per year) during the last decade (see Table 2). Therefore, the share of network products in ASEAN's exports declined to about 48 per cent in 2011.

The improved export growth performance of 'network products' from India has been driven more by assembled products (29 per cent per year) rather than by parts and components (20 per cent per year). As a result, the share of assembled products in India's total exports of network products increased significantly from 44 per cent in 2000 to 60 per cent in 2011. The share of assembled network products in India's total manufactured exports increased from about 3 per cent in 2000/01 to 7.4 per cent in 2010/11<sup>15</sup> while the share of parts and components experienced a marginal increase from 4 per cent to 4.8 per cent during the same period. For example, a small car, motorcycle or generator is an assembled part, as opposed to brake linings, transmission systems, headlights, gearboxes and so on which are parts and components of network products. In the Indian case, the share of assembled products, such

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<sup>14</sup> Note that network products refer to finished goods that are largely assembled involving inputs made globally – i.e., products that are not made in one country from start to finish. Network trade includes these assembled goods and the parts and components involved in them. This is distinct from the overall category of parts and components.

<sup>15</sup> These shares are averages for the given two years. For example, the share of 7.4 per cent for 2010/11 is the average of the shares for the years 2010 and 2011.

as CKDs of small cars, motorcycles and mobile phones grew faster as a share of network trade than did individual parts and components.

Table 3 shows that India's accelerated export growth in assembled network products, was mainly brought about by 'road vehicles' (STIC 78, which correlates with HS 87, or vehicles other than railways, tramways and rolling stock after concordance), and more recently, by 'telecommunication and sound recording equipment' (SITC 76, which correlates with HS 85, or electrical machinery and parts thereof after concordance). Between 2000/01 and 2010/11, the share of road vehicles in India's manufactured exports more than doubled from 2.4 per cent in 2000/01 to 5.3 per cent in 2010/11. Almost all of this increase is brought about by *assembled* vehicles, whose share in manufactured exports rose four-fold, from less than 1 per cent to nearly 4 per cent during this period. Detailed data at the 6-digit level reveals that this increase has been driven by assembled products such as "Automobiles with reciprocating piston engine displacing > 1000 cc to 1500 cc" (HS 870322), "Automobiles with reciprocating piston engine displacing not more than 1000 cc" (HS 870321), "Motorcycles with reciprocating piston engine displacing > 50 cc to 250 cc" (HS 871120) etc. The share of HS 870322 in India's total manufactured exports increased from almost zero in 2000 to more than 1 per cent in 2011. HS 870322 and HS 870321 capture the category of small cars, while HS 871120 is associated with two wheeler motorcycles of a wide range – from 50cc mopeds to 250cc motorbikes. All of these vehicles are composite products where exports very likely embody imported parts, and hence the increased levels of network trade that are evident in the data.

More recently, assembled products within SITC 76 (or HS 85) also recorded rapid growth, and hence its share in total manufactured products increased from a mere 0.3 per cent in 2004/05 to nearly 2 per cent in 2010/11. This increase has been mainly brought about by transmission apparatus for radio telephony incorporating reception apparatus" (HS 852520), whose share in India's total manufactured exports increased from a negligible 0.02 per cent in 2000 to as high as 1.7 per cent in 2011. These product categories are associated with a variety of products such as telephones and mobile phones.

### *3.2.2. The Top Product Groups in India's and ASEAN's Network Exports to the World*

The top 20 product groups in India's exports of manufactured intermediates to the world can be grouped into five broad categories: (i) Machinery, Transport Equipment and Scientific Instruments (HS codes 84, 85, 87, 90); (ii) Basic Metals (HS codes 72, 73, 74, 76); (iii) Chemicals (HS codes 28, 29, 31, 32, 38); (iv) Plastics and Rubber (HS codes 39, 40); and (iv) Other Products (HS codes 48, 54, 60, 70, 71). Together, these product groups account for more than 90 per cent of India's total intermediate exports to the world.

Interestingly, the table also indicates some changes in the structure of India's exports towards more capital (machinery, transport equipment and scientific instruments) and natural resource intensive products (chemicals, metals, rubber) at the expense of traditional labor-intensive manufactured products (gems and jewelry, footwear, garments and so on). The product groups that have gained in shares include "nuclear reactors, boilers etc" (HS 84), various

basic metals and products thereof (iron and steel, copper and zinc), organic chemicals (HS 29) and plastics and articles thereof (HS 39). The product groups that have lost share over the past decade include traditional labor-intensive products such as natural and cultured pearls, precious stones etc. (HS 71) and cotton (HS 52). These latter products, especially gems and jewelry (HS 71) continue to be important given their high overall share in exports, but their growth rates have tapered.

This finding underscores the point that has been made in the literature that India's product mix does not match its resource endowment (Hausmann and Rodrik 2003). The finding is similar to the experience of other large emerging economies such as China and Brazil. Their patterns of specialization are also heterodox and diverge from their factor endowments based comparative advantage. As Chang (2002) and others have noted upgrading and catch-up in the context of global production involves 'some defiance of comparative advantage.'

The top 20 product groups in ASEAN's exports of intermediates to the world account for over 90 per cent ASEAN's total intermediate (manufactured) exports. The data however indicate significant changes in the structure of ASEAN's exports during the last ten years. For example, electrical machinery equipment and parts (HS 85) constituted more than half of ASEAN's intermediate exports in 2000/01, but its share has declined drastically to 23 per cent in 2010/11. By contrast, the export shares of most other products have increased over time. This suggests a shift of ASEAN's basket of exports away from its traditional domain of electrical machinery to other products that are gaining in prominence, or an exit of some electrical machinery parts manufacture to other lower cost countries. But it could also be driven by the dramatic fall in demand for machinery and electronics in the West during the recent recession leading to a re-structuring of supply (Milberg 2010).

Relative to India, ASEAN's export basket is a lot more concentrated on a small subset of products reflecting its greater specialization. Just four product-groups accounted for about 56 per cent of ASEAN's total intermediate exports in 2010/11. (And the degree of concentration was even higher during 2000/01). These product groups (with their 2010/11 shares in parentheses) are: electrical machinery equipment and parts – HS 85 (23 per cent), nuclear reactors – HS 84 (12 per cent), organic chemicals –HS 29 (11 per cent) and plastics and products thereof – HS 39 (11 per cent). India's export basket, by contrast, exhibits relatively greater diversification. For India, only two product groups record an export share above 10 per cent. These are: natural/cultured pearls, precious stone– HS 71 (30 per cent), and organic chemicals - HS 29 (11 per cent).

### *3.2.3. Imports: Deepening Vertical Trade; Parts and Components Imports Grow Faster than Imports of Finished Goods*

Turning now to imports, we find that India's imports of aggregate manufactured products grew faster (23.8 per cent per year) than exports (17.8 per cent per year) during the last decade. India's growth rate of parts and components imports (26 per cent) has been higher than that of end products (21 per cent). As a result, the share of parts and components in India's imports of manufactured goods increased from 54 per cent in 2000 to 65 per cent in

2011. In general, parts and components accounts for a larger share in India's manufactured imports (65 per cent in 2011) than exports (57 per cent in 2011).<sup>16</sup> [For ASEAN components feature prominently in both export and import shares.]

Overall, the patterns of exports and imports noted above suggest that there has been some expansion of assembly activity in India in the recent past. The share of parts and components in India's manufactured imports has increased significantly. However, the share of final products in India's total manufacturing exports remained broadly constant, which may imply that most of the assembly activities in manufacturing are oriented towards the domestic market in India rather than for the export market. A major exception to this is the export of 'network products' where we noted a significant increase in the share of assembled products in the export basket. Therefore within the category of network products, increased product sub-assembly is oriented not only towards the domestic market but also for exports. Even so, despite this modest expansion of export oriented assembly activity in recent years, India remains a net importer of assembled network products. However, recent trends, point to the existence of significant potential for India to expand assembly related export activities in certain categories of network products, such as electrical machinery (SITC 77), professional and scientific equipment (SITC 87), telecommunications and sound recording equipment (SITC 76), office machines and automatic data processing machines (SITC 75) and of course road vehicles (SITC 78).

### ***III.3. Trends and Patterns of Fragmentation Based Bilateral Trade between India and ASEAN***

#### ***3.3.1. Bilateral Exports: Improving Network Trade Shares on Both Sides***

Table 2 reports the average annual growth rates of India's bilateral exports and imports (in current US\$) with ASEAN for different groups of products for the period 2000-2011. It is clear that in aggregate manufactured products India's exports to ASEAN grew at the rate of about 21 per cent per year during 2000-2011, which is higher than India's multilateral export growth (17.7 per cent) during the same period in manufacturing. India's better performance in the ASEAN market compared to its global average is entirely driven by the export of manufactured end products rather than of parts and components. Consistent with the trends noted here, India's export share in the ASEAN market has increased significantly in the case of manufactured end products and assembled network products. Indeed, India's exports of assembled network products to ASEAN grew at a faster pace than India's exports to the rest of the world.

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<sup>16</sup> Table 5 reports the top 20 products in India's imports of manufactured intermediates from the world. The structure of India's imports has undergone some changes in the last decade in favor of product groups such as road vehicles (HS 87), iron and steel (HS 72), articles of iron and steel (HS 73), fertilizers (HS 31) and plastics and articles thereof (HS 39), with a decline in the share of some traditional imports such as 'natural/cultured pearls and precious stone' (HS 71). The pattern of ASEAN's multilateral imports also indicates a major change in the the last ten years. For example, the share of Electrical machinery equipment and parts (HS 85) in ASEAN's total intermediate imports declined sharply from 39 per cent in 2000/01 to only 18 per cent in 2010/11. In contrast, the shares of other product groups either increased (which is the case for most of the product groups) or stayed the same. A similar trend is observed in ASEAN's export basket.

India's exports of assembled products to ASEAN grew at an impressive rate of about 35 per cent per annum, relative to 29 per cent per annum growth in India's multilateral exports in this category. However, India's bilateral exports of parts and components within the category of network products recorded a much slower growth rate (14 per cent per annum) than the corresponding growth in multilateral exports (20 per cent). Clearly, then, Indian exports to ASEAN show an increasing bias in favor of final goods than parts and components. If anything, the share of parts and components in India's exports to ASEAN has declined significantly from 76.5 per cent in 2000 to 56.7 per cent in 2011. This is a recent trend because till 2008 parts and components accounted for a much higher share in India's exports to ASEAN than to the world. In recent years the component share in India-ASEAN exports has declined and converged to the level observed for India's global exports in this area.

It is evident from Table 2 that ASEAN'S imports from India have grown significantly faster than its imports from the rest of the world. Thus, India's market share in ASEAN (i.e., India's share in ASEAN's imports from the World) has steadily increased (from less than 0.5 per cent to nearly 2 per cent). The growth in market share has been sharpest for manufactured end products (nearly 3.5 per cent) and assembled network products (about 2 per cent). During 2000-2011, India's market share in ASEAN has grown at the annual rate of about 16.7 per cent and 23.3 per cent respectively for manufactured end products and assembled network products, but has been very low for manufactured parts and components (7.5 per cent per annum) and parts and components of network products (7.8 per cent).

Within network products, the specific product groups that have contributed most to India's high export growth in the ASEAN market are not different from those that have driven India's overall export growth in these categories globally. As Table 6 shows, as in the case of India's multilateral exports, the product groups that have recorded the fastest export growth in ASEAN are 'road vehicles' (STIC 78) and 'telecommunication and sound recording equipment' (SITC 76). The share of road vehicles increased quite dramatically from 1.7 per cent in 2000/01 to 6.5 per cent in 2010/11. And much of this increase was due to the rise in the export of *assembled* road vehicles, whose share in manufactured exports increased from less than 1 per cent to above 4 per cent during this period. The export share of parts and components of road vehicles also registered a modest increase from 1.2 per cent to 2.2 per cent over the last decade. A bulk of these assembled components belong to a vehicle's chassis, brake lining system, transmission, spark ignition engines, gear boxes, shock absorbers, or wheel related systems. For bicycles the parts include hubs, sprockets and other parts. The overall pattern of India's export of 'road vehicles' parts and assemblies to ASEAN does not look very different from its exports in this area overall.

Most recently, exports of assembled products in the telecommunications equipment area (within SITC 76 or HS 85) have registered gains in the ASEAN market pushing up India's share of this category of manufactured exports to ASEAN from a mere 0.2 per cent in 2004/05 to nearly 2.4 per cent in 2010-11. This increase has been almost entirely driven by transmission equipment and mobile phone related components, specially 'transmission apparatus for radio telephony incorporating reception apparatus' (HS 852520), whose share

increased from a negligible 0.04 per cent in 2000 to as high as 2.2 per cent in 2011. This pattern within SITC 76 (or HS 85) is very similar to the pattern of India's overall multilateral exports, signifying that India's improved performance in ASEAN is part of the overall evolution of India's vehicle and telecommunications sectors, its growing competence in this area, rather than shifts by AIFTA.

The top 20 product groups in India's exports of manufactured intermediate products (at the two digit HS level) to ASEAN are listed in Table 7. These product groups together account for more than 90 per cent of India's total intermediate goods exports to ASEAN. Consistent with the pattern observed for India's overall multilateral exports (see Table 4), the product groups that have gained export share in the ASEAN region are capital-intensive while the groups that had experienced a decline are traditional, labor intensive products. A majority of the sectors where India's exports have grown and gained share between 2000 and 2011 fall under the category of Medium-High Technology Industries (e.g., HS 85, 87, 29) or High Technology Industries (HS 30, 90 and some categories of HS 85 such as transmission and recording equipment and optical equipment).

However, there are some important differences in the structure of India's exports to ASEAN relative to the world. Most notably, 'organic chemicals' (HS 29) feature as an important export category for India in the ASEAN market. The share of HS 29 in India's exports to ASEAN has increased remarkably from 13 per cent in 2000/01 to 21 per cent in 2010/11. By comparison, the share of HS 29 in India's manufactured exports to the world increased by only a modest amount (from 9 per cent to 11 per cent) during the same period. Organic chemicals are clearly an important export for India in the ASEAN market.

Other product groups where Indian exports to ASEAN have grown faster than the global average include 'nuclear reactors, boilers etc' (HS 84), and 'vehicles o/t railw/tramw' (HS 87). In the case of HS 87, India's export growth in the ASEAN market grew much faster than in the world. Similarly, Table 4, which reports the structure of India's multilateral exports, shows that all product groups (except aluminium) within 'basic metals and products' recorded higher shares in 2010/11 compared to 2000/01. But in India's bilateral exports to ASEAN only two product groups (copper and zinc) in this category recorded an increase. As is the case with India's multilateral exports, the product groups that have lost their share in the ASEAN market include traditional labor-intensive products such as 'natural and cultured pearls, precious stones etc' (HS 71) and 'cotton' (HS 52).

### *3.3.2. An Analysis of Export Intensities*

How do India's manufactured exports to the ASEAN region compare with the structure of ASEAN's own imports from the world and vice versa? Is India supplying in categories that are important to ASEAN, and are there opportunities that India's is missing and can potentially grow into? This comparison shows that India's shares (reported in Table 7) in almost all the production categories related to machinery, transport equipment, and scientific equipment (Category I in our scheme) are considerably lower than ASEAN's corresponding import shares from the world. By contrast, India's shares are higher than world shares for

products grouped under Category III (Chemicals), particularly in ‘Organic Chemicals’ (HS 29). In 2010/11, ‘Organic Chemicals’ accounted for more than 20 per cent of ASEAN’s imports from India while its share in ASEAN’s imports from the world is only 6 per cent. This suggests that India has a significant potential to expand its ASEAN export share in the machinery sector, while also building on its existing strength in the chemicals sector to expand more fully in the ASEAN market.

To systematize this analysis, we estimated India’s export intensity in the ASEAN market by dividing India’s export shares reported in Table 7 by world export shares. We compute two separate indices of export intensity as follows.

$$EI_1 = \frac{S_{ia}}{S_{wa}} \quad \text{and} \quad EI_2 = \frac{S_{ia}}{S_{iw}}$$

where  $S_{ia}$  represents the share of a product group in India’s ( $i$ ) total exports of intermediates to ASEAN ( $a$ );  $S_{wa}$  denotes the share of the same product group in the world’s ( $w$ ) total exports of intermediates to ASEAN; and  $S_{iw}$  is the given product group’s share in India’s exports to the world. The export intensity indices are the ratios of the two shares. The value of  $EI_1$  index indicates whether or not India’s export basket is overrepresented or “biased” towards ASEAN in those categories than exports from the world to ASEAN on average. Similarly, the value of  $EI_2$  shows whether or not India’s export basket shows a bias toward the ASEAN relative to India’s exports in those categories to the world as a whole. A value greater than 1 for  $EI_1$  indicates that India’s export share in those categories is larger than the world’s share to ASEAN; and a greater than 1 value for  $EI_2$  implies that in those categories ASEAN is a particularly important market for India relative to the world.

Values for the  $EI_1$  index indicate that India has a high export intensity in ASEAN for most chemicals (except miscellaneous chemicals and Essential oils & resinoids), some basic metals (Iron & steel, Copper and Aluminium) and most of India’s traditional export items (gems & jewellery, man-made filaments, cotton and manmade staple fibres). There is a disproportionate presence of these product groups in India’s export basket to ASEAN.<sup>17</sup> The product groups with low  $EI_1$  values include most of the machinery items, articles of iron & steel and plastics. ASEAN prefers to import these intermediate goods from other countries than India.

While the  $EI_1$  index may indicate India’s general bias towards or against a particular product group, the  $EI_2$  measures India’s specific bias in the given product group towards ASEAN relative to other markets. The values of  $EI_2$  index show a somewhat different picture of India’s export intensity with ASEAN, particularly in the machinery sector (intermediates related to the machinery sector). With the notable exception of ‘electrical machinery equipment and parts’, the values of the  $EI_2$  index show a significant increase for all product groups under Category I. This indicates India’s growing export orientation towards the ASEAN market in these products. In fact, over the last 10 year period this trend has

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<sup>17</sup> Of course, this bias may be present in India’s exports to other trading partners as well, not just in the case of ASEAN.



intensified, and by 2010/11, the values of the  $EI_2$  index had risen significantly above 1 in many of these categories.

The puzzling finding is that India's export orientation towards the ASEAN market shows a steady decline in the case of 'electrical machinery equipment and parts'. This is a matter of concern given that, this product group continue to hold the top position in ASEAN's multilateral trade (both imports and exports) despite its declining share over the past decade. It is clearly a potential area for India to do better.

Overall, based on  $EI_2$  values for the year 2010/11, we can conclude that there is a significant potential for India to increase its vertically specialized export to ASEAN in the following three product spaces: (i) 'Electrical machinery equipment and parts' (HS 85); (ii) Articles of Iron & Steel (73); (iii) all product groups under category V (that is India's more traditional products such as gems and jewelry and textiles (particularly man-made filaments, cotton and manmade staple fibres). In addition, we can identify two major products within HS 84 where India holds an unexploited potential in the ASEAN market. These are: "Parts for diesel and semi-diesel engines" (HS 840999) and "Parts for spark-ignition type engines nes" (HS 840991). Similarly, India's  $EI_2$  values are very low for most of the products within HS 85, which implies that there is a significant potential to expand Indian exports in this group.<sup>18</sup>

Finally, based on the  $EI_2$  values, the major products within 'Plastics' (HS 39) and 'Rubber' (HS 40) with a high export potential, are "Polyethylene terephthalate, in primary forms" (HS 390760) and 'New pneumatic tyres, of rubber, nes' (HS 401199), respectively. The  $EI_2$  values are well below 1 for most of the products within the traditional labor-intensive group represented by Category V (Other Products), with the notable exception of some products such as "Oil-cake and other solid residues, of soya-bean" (HS 230400), "Bovine and equine leather, prepared after tanning" (HS 410439), "Oil-cake and other solid residues of rape" (HS 230640), and "Precious or semi-precious stones nes" (HS 710399). The most important product in Category V, in terms of export value, is "Diamonds non-industrial nes excluding mounted" (HS 710239) whose  $EI_2$  index is only 0.3. Overall, there exists a significant potential for the expansion of trade in these employment-intensive categories.

### *3.3.3. Bilateral Imports: High Value, Technology-Intensive Products Dominate India's Import Basket*

Having analyzed the structure of exports from India to the ASEAN market, we now analyze the structure of India's imports from ASEAN. Referring back to Table 2, India's imports of aggregate manufactured products from ASEAN grew at a similar rate (20.6 per cent per annum) as that of exports (20.9 per cent per annum) during the last decade. However, India's imports from ASEAN grew slower than India's overall imports from the world (23.8 per cent per year). This is in contrast to the pattern with exports, where Indian exports to ASEAN

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<sup>18</sup> Export growth within HS 87 has been driven by 'Motor vehicle parts nes' (HS 870899), and 'Tansmissions for motor vehicles' (HS 870840). The  $EI_2$  values of these fast growing products have increased significantly. It may also be noted that one product within HS 84 - 'parts and accessories of automatic data process' (847330) - has recorded a significant decline in its share of exports to ASEAN from as high as 8.5 per cent in 2000/01 to as low as 0.8 per cent in 2010/11.<sup>18</sup> At the same time, the share of 'Aircraft parts nes' (HS 880330) has increased from 0.5 per cent to 2.3 per cent during the same period.

grew faster than Indian exports to world. India's lower import growth from ASEAN compared to that from the world is entirely due to manufactured parts and components which grew at a lower growth rate of 20.2 per cent per year in the bilateral case (as opposed to 25.9 per cent in the multilateral case). For network products, India's import growth from ASEAN is particularly small compared to India's overall import growth. Further, in this case, the bias against ASEAN can be seen not only for parts and components but also for assembled network products. Within network products, parts and components imports from ASEAN grew at 14.9 per cent per year compared to a much larger growth rate of 21.8 per cent from the world. A similar pattern is evident for assembled network products where imports grew at the rate of 19.3 per cent in the bilateral case as opposed to 25.2 per cent in the multilateral case. In contrast, as noted earlier, India's exports of assembled network products to ASEAN showed a strong growth of about 35 per cent per annum.

Consistent with the trends noted above, ASEAN's share in India's imports has declined significantly for different categories except for manufactured end products where the share remains constant. The decline is particularly pronounced for network products, both assembled and parts. Until 2009 parts and components had accounted for a lower share in India's bilateral imports than exports and this has changed to the opposite during the last two years, which has been driven by India's high export growth of end products to the ASEAN market. In recent years, the component share in India-world imports has increased and the bias that India had displayed in the past towards the ASEAN market for components trade (both exports and imports) has disappeared.

Though India's import growth rate from ASEAN has not kept pace with the growth rate of India's imports from the world, it is crucial to note that India has been a fast growing market from the point of view of ASEAN's exports. It is evident from Table 2 that in all product categories India's imports from ASEAN have grown considerably faster than the latter's exports to the world. During 2000-2011, India's share in ASEAN exports grew at the annual rate of about 12.7 per cent and 13.3 per cent respectively for manufactured end products and assembled network products. Manufactured parts and components and parts and components of network products grew at just slightly lower rates – 10 per cent and 8.6 per cent per annum respectively. Overall, India's share for ASEAN's exports has grown consistently in recent years.

It is clear that the structure of India's imports has undergone major changes in favor of product groups such as 'organic chemicals' (HS 29), followed by 'plastics and products' (HS 39) and 'nuclear reactors, boilers' (HS 84). The share of 'organic chemicals' increased from 13 per cent in 2000/01 to 21 per cent in 2010/11, mimicking the pattern on the export side of the Indo-ASEAN trade relationship. Other product groups that have increased their shares in India's imports include: 'road vehicles' (HS 87), 'printed books and newspapers' (HS 49) and all product groups within the broad category of 'basic metals and products' (except for 'nickels' where the share remains constant). Two key product groups have witnessed a decline in import shares in the last decade. The share of 'Electrical machinery, equipment and parts' (HS 84) in India's imports fell significantly from 22 per cent in 2000/01 to 14 per

cent in 2010/11. Likewise, traditional labor-intensive product groups such as ‘natural/cultured pearls’ (HS 71) and ‘man-made filaments’ also registered a falling share, as did chemicals other than ‘organic chemicals.’

It would also be instructive to compare India’s import structure from ASEAN with the structure of the latter’s exports to the world. This comparison shows that India’s shares (reported in Table 8) are considerably lower than the corresponding world shares for many intermediate product categories led by ‘electrical machinery equip parts’ (HS 85). Dividing India’s import share by ASEAN’s world export shares (Table 9), we find that ASEAN has a high export intensity in chemicals and lower export intensity in Machinery items (except for HS 84), basic metals and a variety of miscellaneous categories of traditional export. Clearly, then, there is a significant potential to expand mutual trade (exports and imports) between ASEAN and India in machinery items and in those categories where performance is sub-par. Such two-way trade already appears to be high in chemicals.

### 3.3.4. An Analysis of Vertical and Horizontal Measures of Bilateral Intra-Industry Trade

Using the Grubel-Lloyd index, we measure the extent of intra-industry trade (IIT) in intermediate products between India and ASEAN – that is, the simultaneous occurrence of exports and imports within the same industry. The index of IIT in industry  $j$  and year  $t$  in trade of the country under consideration is defined as:

$$IIT_{jt} = \frac{(X_{jt} + M_{jt}) - |X_{jt} - M_{jt}|}{(X_{jt} + M_{jt})}$$

where:  $X_{jt}$  = value of exports from India to ASEAN in industry  $j$  and year  $t$   
 $M_{jt}$  = value of imports to India from ASEAN in industry  $j$  and year  $t$

While  $IIT_{jt}$  measures IIT in a specific industry (i.e. within each HS 6-digit product), its trade-weighted average can be used to measure IIT in the aggregate groups of industries and in the entire manufacturing sector.

For each product at the 6-digit level, we separate total IIT into its two components – *horizontal* and *vertical* – using relative unit values of export and imports. The rationale for using unit values is that a product variety sold at a higher price must be of higher quality (or represents a higher stage of processing in the case of intermediate products) than a variety sold more cheaply. Of course, there are well known issues that complicate this assumption, such as a different cost environment, but the literature uses unit value comparisons widely, but with these caveats in mind. In our case, horizontal IIT (HIIT) represents an exchange of commodities with broadly similar levels of quality or stage of processing while vertical IIT (VIIT) is defined as the exchange of commodities with different levels of quality or stage of processing. Following the general practice in the literature, IIT is identified as horizontal (HIIT) if the ratio of export unit

value to import unit value is within the range of 0.75 to 1.25. When the ratios are outside the specified range, any IIT is considered to be vertical in nature (VIIT).<sup>19</sup>

The IIT indices ( $IIT_{jt}$ ,  $HIIT_{jt}$ , and  $VIIT_{jt}$ ) have been calculated for each product at the HS 6-digit level. Table 10 reports the trade-weighted averages of these indices for different product groups at the HS 2-digit level. The overall index (see the last row in Table 10) suggest that for the year 2000, about 26 per cent of India's bilateral trade with ASEAN in manufactured intermediates was IIT. This share had fallen to 21 per cent in 2005 but then registered an increase to 29 per cent in 2011. Between 2000 and 2011, the individual products that have recorded an increase in the value of the IIT index include, "Vehicles o/t railw/tramw" (HS 87), "Electrical machinery equipment and parts" (HS 85), "Optical, photo, cine, meas" (HS 90). All these product groups belong to our Category I (Machinery, transport equipment and scientific instruments). It is particularly striking that the IIT index in HS 87 increased steadily from 27 per cent in 2000 to 64 per cent in 2005 and to as high as 74 per cent in 2011. In general, the product groups within Category I record higher levels of IIT compared to the product groups belonging to other categories. A major exception is HS 85, where the IIT index is relatively low.

Within the category of "chemicals", the product groups that have recorded an increase of the IIT index include: "tanning or dyeing extracts" (HS 32) and "essential oil and resinoids" (HS 33). "Organic chemicals", a major product group for India-ASEAN trade, however, shows a declining intensity of IIT from 38 per cent in 2000 and 2005 to 26 per cent in 2011. Within Category IV, "rubber and products" recorded a higher IIT index in 2011 while "plastics and products" recorded a significantly lower IIT index. Within Category V (other products), two product groups ["pearls, precious stones etc" (HS 71) and "man-made filaments" (HS 54)] recorded an increase in IIT while two other product groups ["paper and paperboard" (HS 48) and "raw hides and skin" (HS 41)] saw a decline. The product groups within Category II (Base metals) did not show any particular trend. Two product groups that show relatively high levels of IIT within Category II are: "articles of iron and steel" (HS 73) where the 36 per cent of the trade is IIT, and "copper and articles" (HS 74) where nearly 40 per cent of the trade is in intermediates.

As to the decomposition of IIT into horizontal and vertical IIT, we find that for the year 2000, about 21 per cent of India's trade with ASEAN represented VIIT while the remaining 5 per cent was HIIT. The relative importance of HIIT, however, increased significantly in 2011 accounting for 12 per cent of trade while VIIT accounted for the remaining 17 per cent.

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<sup>19</sup> It is important to point out here a key deficiency of the horizontal and vertical IIT estimates. The methodology rests on the assumption that when one considers the export unit value and import unit value the same product is being compared. For an analysis done at 6-digit level, this may not be true in all cases. Certain 6-digit codes may have three or four 8-digit codes under them, and India may be exporting mainly one 8-digit category and importing another 8-digit category. Thus, one would be more confident of the estimates of horizontal and vertical IIT if the analysis is done at 8-digit level than at 6-digit level. This criticism applies also to the sub-division of vertical IIT into high quality and low quality. We thank Dr. B.N. Goldar for pointing out to us. This important caution aside, we present VIIT and HIIT here to reflect on the potential for upgrading that may exist in the structure of India's component exports in sectors where mutual trade is significant.

Thus, it is clear that despite the increasing importance of HIIT, vertical relationships continue to dominate India's IIT with ASEAN. That is, India imports products of higher value or stage of processing than it exports.

### 3.3.5. *High Quality vs. Low Quality VIIT*

We can further subdivide the VIIT into two categories - high-quality or high value VIIT (HVIIT) and low-quality VIIT (LVIIT). If the ratio of the unit value of export to import is greater than 1.25, then the quality or processing stage of exports is higher than that of imports (HVIIT), while ratios below 0.75 may indicate higher quality or processing of imports compared with exports (LVIIT). It is clear that in 2011 much of the VIIT in Category I represents LVIIT, which implies that the unit values of products exported by India are generally lower than that of imports. A major exception is "Optical, photo, cine, meas" (HS 90) where India's export unit values are higher than import unit values for the year 2011. Also, for the year 2000, two product groups (HS 84 and HS 88) within Category I showed higher unit values of exports than imports. These exceptions notwithstanding, it can be seen that the export unit values are generally lower than import unit values for the products grouped under Category 1. A similar pattern can be observed for other Categories as well. Two major exceptions are "rubber and products" (HS 40) and "organic chemicals" (HS 29) where HVIIT generally dominates over LVIIT.

### 3.3.6. *The Skill Composition of India's Exports*

Using the factor intensity classification of the International Trade Centre (ITC), adapted by Hinloopen and van Marrewijk (2008), we classify India's traded products into four specific categories: natural resource-intensive, unskilled labour-intensive, human capital-intensive and technology-intensive. This classification makes use of data disaggregated at the 3-digit level of SITC (Revision 2)<sup>20</sup>. Calculations are done after mapping HS 6-digit codes on to SITC (Rev 2) 3-digit codes. From the findings it is evident that the share of capital-intensive products in India's exports to ASEAN has increased significantly from about 61 per cent in 2000/01 to 75 per cent in 2010/11. Within the category of capital-intensive products, both the subcategories - human capital-intensive and technology-intensive - have increased their shares though the increase is more pronounced for technology-intensive products. In contrast, the shares of natural-resource intensive and unskilled labor-intensive products have declined significantly. A similar trend can be observed in India's overall exports to the world. In 2010/11 54 per cent of India's manufactured intermediate exports fell into the capital intensive category, up from 42 per cent in 2000/01.

This trend is clearly more pronounced for ASEAN. Between 2000/01 and 2010/11, the share of capital intensive products in India's manufactured intermediate exports to the ASEAN increased from 61 per cent to over 75 per cent, while the share of natural resource based

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<sup>20</sup> The classification is available at: (<http://www2.econ.uu.nl/users/marrewijk/eta/intensity.htm>). A total number of 240 items, at the 3-digit SITC level, have been grouped into five categories (number of items in each category in parentheses): primary (83), natural-resource intensive (21), unskilled-labor intensive (26), human capital-intensive (43), technology-intensive (62), and unclassified (5). For our purpose, we define an additional category, called capital-intensive category, by adding human capital-intensive and technology-intensive categories.

intermediate exports fell from 26.5 per cent to 16 per cent and labor intensive exports (using unskilled labor) fell from 31 per cent to just 8 per cent. The share of natural resource intensive products in India's manufactured intermediate exports to the world though falling, is higher than in ASEAN, nearly a third in 2010/11; and similarly the share of unskilled labor intensive manufactured intermediates exports to the world was 11 per cent in 2010/11 relative to 8 per cent for ASEAN. Clearly then, compared to multilateral exports, India's export composition to the ASEAN reveal a clear bias in favor of technology-intensive products and against unskilled and natural-intensive products.

A second point to note is that within the category of India's capital intensive manufactured intermediate exports, technology intensive exports dominate human capital intensive exports. More than half (53 per cent) of India's capital intensive intermediate exported to ASEAN were technology intensive exports in 2010/11 were technology intensive products, while 23 per cent were human capital intensive products. For the world, these shares were more modest, but even here technology intensive exports dominated human-capital intensive exports (33 per cent and 22 per cent respectively). While the shares of human capital intensive intermediate exports are about the same in the world as in ASEAN (about 22 per cent) and grew by a modest 4-5 percentage point over the past decade, the share of technology intensive manufactured intermediate exports grew much faster – by nearly nine percentage points for the world, from 24 per cent in 2000/01 to 33 per cent in 2010/11, and nearly 11 percentage points for ASEAN from 42 per cent to 53 per cent. These findings are in broad concurrence with findings based on the technology composition of exports.

#### *3.4. Summing Up*

Our trade data analysis shows that there is evidence of a steady growth in India's integration with global production networks. India's intermediates exports grew much faster (25 per cent per year) than its aggregate manufactured exports (18 per cent per year) during the ten year period we studied, and India's share of 'network' exports (assembled end products) doubled during this period. Imports showed a similar trend. By 2011 parts and components comprised 65 per cent of India's manufactured imports (up from 54 per cent in 2000), and 58 per cent of its manufactured exports. India's engagement with ASEAN grew at a faster pace than multilateral trade during this period. This was led by exports which grew at an impressive 35 per cent a year (relative to 29 per cent a year for the world). However, Indian exports to ASEAN show an increasing bias in favor of final goods (including assembled goods) rather than parts and components.

The data also indicate shifts in the structure of India's exports with a growing bias towards more capital intensive and natural-resource intensive products (machinery, transport equipment, and instruments; and chemicals, metal and rubber respectively) at the expense of traditional, labor-intensive manufactured exports. The structure of India's imports has also undergone some changes in the last decade in favor of product groups such as road vehicles (HS 87), iron and steel (HS 72), articles of iron and steel (HS 73), fertilizers (HS 31) and plastics and articles thereof (HS 39). As observed on India's export side, the share of 'natural/cultured pearls and precious stone' (HS 71) has declined on the import side as well.

The analysis also indicates a major change in the structure of ASEAN's exports and imports during the last ten years. Most striking was that the share of electrical machinery, equipment and parts, a mainstay of ASEAN's economy, declined sharply in total manufactured intermediates exports and imports. This suggests a shift of ASEAN's manufactured intermediates trade away from its traditional dominance of electrical machinery to other products that are becoming more prominent. It could also imply chain upgrading as some segment of HS 85 shift to other countries; or then it could reflect a restructuring of production following the fall in demand for electronics and machinery globally during the recent recession.

The faster growth of imports relative to exports has led to an increasing trade deficit in India's aggregate manufacturing trade, but the data show a nuanced picture. Since 2008 the trade balance turned into surplus for manufactured final goods, but remained negative for manufactured parts and components. Indeed, the trade balance in network products did even better, and has been in surplus since 2007 given that exports of assembled network products grew faster than imports. By contrast, ASEAN has always had a strong trade surplus in nearly all categories of products, especially assembled network products and other manufactured end products.

On the whole, these trends suggest an expansion of assembly activity in India in recent years. The share of parts and components in India's manufactured imports has increased significantly. However, given a steady share of final manufactured exports, this suggests that a fair bit of the assembly activities in Indian manufacturing are oriented towards the domestic market. The large size of the market is an important source of growth for Indian manufacturing.

While the large size of the domestic market has been an important source of growth for Indian manufacturing, the data also suggest that there is significant potential for India to expand assembly related export activities in certain categories of network products, such as electrical machinery (SITC 77), professional and scientific equipment (SITC 87), telecommunications and sound recording equipment (SITC 76), office machines and automatic data processing machines (SITC 75) and of course road vehicles (SITC 78), including in ASEAN.

The analysis of bilateral intermediates and network trade data between India and ASEAN showed that India's manufactured trade with ASEAN had grown faster than the world. India's aggregate manufactured exports to ASEAN grew at 21 per cent per year during 2000-2011, relative to 17 per cent per year for the world. However, India's better export performance in the ASEAN market is driven by the export of end products rather than of parts and components.

Still, ASEAN'S imports from India have grown significantly faster than its imports from the rest of the world and thus India's market share in ASEAN has steadily increased (from less

than 0.5 per cent to nearly 2 per cent). Growth was sharpest for manufactured end products (nearly 3.5 per cent) and assembled network products (about 2 per cent).

Consistent with the pattern observed for India's overall multilateral exports, the product groups that have gained export share in the ASEAN region are capital-intensive while the groups that had experienced a decline are traditional, labor intensive products. The product groups that lost share in the ASEAN market include traditional labor-intensive products such as 'natural and cultured pearls, precious stones etc.' (HS 71) and 'cotton' (HS 52).<sup>21</sup>

While India's engagement with ASEAN has increased significantly in the last ten years and its market share in ASEAN has grown, is India supplying in categories that are important to ASEAN? We found that India's shares in almost all categories related to machinery, transport equipment, and scientific equipment (Category I in our scheme) are considerably lower than ASEAN's corresponding import shares from the world. By contrast, India's shares are higher than world shares for products grouped under Category III (Chemicals), particularly in 'Organic Chemicals' (HS 29). This suggests that India has a significant potential to expand its ASEAN export share in the machinery sector, while also building on its existing strength in the chemicals sector to expand more fully in the ASEAN market.

Overall, India's imports from ASEAN grew slower than India's overall imports from the world (23.8 per cent per year). This lower import growth was primarily due to the slowdown in the imports of manufactured parts and components. Even though India's import growth rate from ASEAN has not kept up with the rise in India's multilateral imports, a crucial finding is that India has been a fast growing market from the point of view of ASEAN's exports. This is an important base on which to build. Based on ASEAN export intensities in the Indian market, it is clear that there is a significant potential to expand mutual trade between ASEAN and India in all kinds of machinery intermediates including electronics, electrical machinery and telecommunications and transmission equipment.

There are additional areas where India can improve its performance by trying to progressively upgrade export based. For example, at the moment, India in general, imports products of higher value or stage of processing than it exports. Almost all the inter industry trade in categories such machinery, transport equipment and scientific instruments (Category I) is vertical IIT – that is, exchange of products with different levels of quality or stage of processing. The same is the case for organic chemicals and inorganic chemicals where the unit values of products exported by India are generally lower than that of imports.

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<sup>21</sup> The big difference between India's exports to ASEAN relative to the world was the notable importance of 'organic chemicals' (HS 29) for India's in the ASEAN market. The share of organic chemicals in India's exports to ASEAN increased from 13 per cent in 2000/01 to a striking 21 per cent in 2010/11, and reflects two way trade, as India's imports of organic chemicals from ASEAN also increased strongly during this period. The end markets that this processed input is used in includes aromatics of all sorts, industrial solvents, herbicides, pesticides, food processing and pharmaceuticals. The Indian chemical industry, as well as the government is interested in promoting the growth of specialty chemicals, so this is an area to watch in the future.



Finally, we found that the skill composition of India's exports reflects the dominance of capital intensive intermediates and network exports from India. Both human capital-intensive and technology-intensive exports increased their shares, with technology-intensive product shares rising faster. By contrast, the shares of natural-resource intensive and unskilled labor-intensive products declined significantly. India's overall exports to the world reflect a similar trend. This has important implications for the employment elasticity of India's emerging export patterns.

#### **IV. View from the field: Firm level analysis**

In this section we report on findings from twenty semi-structured open-ended interviews that we conducted with a purposively drawn sample of firms and industry associations in product categories that are important for India's vertically specialized trade with ASEAN (and the globe). We spoke with firms in sectors where such trade is high, as well as with those where significant potential exists for India in the ASEAN market but where current growth is low. In the former category we interviewed firms in the road vehicles or automotive and auto components sector (HS 87) and in the chemicals and organic chemicals (HS 29) sector that the data show are particularly important categories for India in the ASEAN market. In terms of sectors where there is significant underexploited potential we interviewed firms in the electrical machinery, equipment and parts sector (HS 85) and non-electrical machine tools (HS 84). In addition to firms, we interviewed government officials and leading industry associations in each sector. These interviews shed light on how specific (leading) firms view their own participation and performance in production networks, why they participate (or do not) in these networks, what drives vertical specialization where it does occur, and what are some bottlenecks to wider integration of Indian firms in production networks, as well as to industrial upgrading.

Broadly, the interviews underscore the finding from the data analysis that during 2000 and 2011 India's vertically specialized export shares with ASEAN and the world that have grown fastest in relatively capital intensive product categories while shares and growth rates in traditional, labor intensive product groups (textiles, leather, gems and jewelry) have declined during this same period. The interviews also show that India's vertical specialization in exports embodies more assembled end products than it does parts and components. The picture on the import side is mixed and varies by sector. The interviews also show that India imports higher value and more technologically advanced parts and components than it exports. Finally, Indian firms see ASEAN as an important potential market, especially after AIFTA, India-Japan, India-Korea CEPA and the India-Malaysia CECA were signed. At the same time they point to the difficulty of deepening production and trade ties with ASEAN, despite the FTA, given ASEAN's long-standing and deep linkages with China, which is far more competitive in the region relative to India.

Why has India's integration in global markets been slow even after 25 years of liberalization and economic reforms of the early 1990s? The literature has identified several factors that

determine vertical specialization and production sharing within global or regional networks. Some of these factors include trade costs, export oriented FDI, locational advantages and “service link” costs. Tariffs are important, but the presence of export-processing zones, duty suspension, and drawback facilities for export-oriented production activities, as well as FTAs mitigate their direct impact. Others have shown that structural factors in the home country, such as access to finance and intra-period credit, quality of infrastructure, skill levels, governance and political stability, are important. Yet others have spoken of scale and scope economies and capacity to deliver on time are equally important so as not to disrupt production plans for the entire production chain.

Our interviews showed that several of these “drivers” are missing in Indian manufacturing: there are low levels of outward oriented FDI, low levels of value addition locally, very high “service costs,” high interest rates, poor credit markets and very poor infrastructure and logistics support, topped by severe shortages of reliable power supply, all of which undermine the capacity of firms to deliver to quality and on time. Rising land costs and complications in the acquisition of land further add to costs and project uncertainty. In addition there are sub-optimal scales of production, critical segments in the production chain that are missing, such as hardware and high quality inputs, coupled with low levels of R&D complicate efforts at upgrading. On the face of it therefore there is good reason for poor global integration in India’s manufacturing sector. Despite these drawbacks, the manufacturing sector is trying to upgrade, as the data analysis showed, in part, and is making some headway. And the government is trying to bridge some of the gaps.

Keeping the obvious lacks in mind we take a closer look at what specifically emerged from our interviews about processes that constrain firms and what are ways to get past them.

#### *4.1. Power-sector subsidies, price-pressured end-users and their innovation dampening effects: The challenges of upgrading with a primarily domestic focus*

The electrical machinery sector in India is currently focused primarily on the large domestic market. Only 18 per cent of the sector’s US\$ 22 billion worth of output is exported. The bulk of its output of boilers, generators, transmission and distribution equipment is oriented toward public sector utilities and power companies (IEEMA Interview, 2013). Given the vast demand for power in India, the large size of the domestic market could be an important source of scale and stability that can foster growth, development and upgrading in the sector, but the opposite is the case. Save some exceptions, the industry has very low levels of value addition and stagnant technology. Indian firms cannot compete with the global competition in many key sub-segments and imports have been growing. For example, there is significant import of BTG (Boiler Turbine Generator) equipment (at ~13 per cent) in the boiler segment, which constitutes a major share of the sector. Imports are predominantly from countries such as China and Korea. Due to the emergence of new technologies, such as supercritical technology, the market share of foreign BTG players has been rising in the total orders placed (Annual Report 2012-12 pp 27). More than 80 GW of supercritical BTG sets have been awarded by India so far, of which more than 68 GW (85 per cent) have been awarded to

foreign players, with Chinese players capturing more than 80 per cent of the overseas orders. Domestic players significantly lag behind their global peers in adding BTG capacity in the supercritical boiler and turbine segments, as also in other key technologically advanced components (Ministry of Heavy Industries and Public enterprises, pp28)<sup>22</sup>

In our interviews respondents repeatedly attributed the sector's lagging technology to the fact that their main clients are Utilities and power companies whose primary concern is low costs and low end-prices. They were quick to point out exceptions and instances of upgrading in other product segments: e.g., transmission is now being done through smart grids, ABB produces circuit breakers in India for global exports, transformers produced in India are exported to the West, BHEL and Siemens are collaborating to produce supercritical sets. However overall the lagging technology in the vast power generation and distribution sector has kept the industry bogged down.

As is the case with all public sector companies, the utilities award projects through a tendering system and applicants are judged at two levels. They are first required to meet a set of technical standards, which according to the respondents are quite basic – adequate but rudimentary. Once a bidder qualifies on technical grounds they are evaluated on their financial offer with the contract going to the lowest bidder. If some company comes up with a technically better product or an innovative technical process, they are out-bid on price. The main objective of the companies therefore becomes to just meet the basic parameters rather than to propose new things or new ways of doing things. This 'least-common-denominator' approach to technical standards eliminates incentive on the part of the supplier firms to innovate or move towards the industry frontier. "If [the government's] technical standards are higher and the norms more stringent, then better products will come up" (IEEMA Pandit Interview, March 2013).

A second key issue that reinforces this low-level equilibrium trap is India's electric power subsidies. On the face of it, the utilities' use of a no-frills bidding process to keep prices down is not unusual – it happens all around the world. But steep power sector subsidies create an added negative feedback loop that further retards the sector's technical growth (IEEMA Interview March 2013). The politics around power prices is well known. They keep electricity prices artificially low which has a ripple effect throughout the value chain from generation to transmission to distribution. Since power companies have to provide electricity at a low price, they have to produce it at an even lower price. This leads to "cutting down project costs by the use of cheap products, or inferior quality equipment" which eventually traps the system in a low-technology, low-efficiency, low-productivity cycle (Pandit Interview March 2013).

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<sup>22</sup> For more details see the government's Indian Electrical Equipment Industry Mission Plan 2012-2022: Base Document, September 2011, Ministry of Heavy Industries and Public enterprises.

When asked about cutting costs through upgrading or innovation, the response was that most generation and distribution companies have low profit margins to begin with. Given the unsustainably low prices at which they have to deliver power, and the losses they have to deal with, many are in the red, “there is no money to make new investments and [firms] are not interested in upgrading” (IEEMA Interview, March 2013). As a consequence the price pressures that cascade down the chain have an adverse effect on innovation and R&D, creating long term sector-wide weaknesses that saddle the industry with obsolete and lagging technology.

The irony is that in reality the purported cost-saving wrested from squeezing prices and imposing just-acceptable, minimal technical standards at the front end, prove illusionary and end up only hurting the sector. They add to costs rather than saving them. They add to costs, first, by discouraging modernization that keeps high-cost system-wide inefficiencies locked in. Second, the low technical standards to which the sector is held and the “fixes” adopted by firms to cut costs, can lead to more frequent breakdowns, work-stoppages and productivity losses which end up adding to costs over time rather than cutting them. By contrast, a lifecycle view of costs – unit costs and efficiencies over time – would reveal that fostering continuous innovation, learning and upgrading within the sector by incrementally ratcheting up standards in gradual congruence with global norms would lead to greater cost savings from the better performance of the equipment and the higher productivity of the system as a whole. These benefits could be passed on to the consumer or invested in R&D. Some policy makers and government officials are beginning to look at life cycle costs and are of the view that if a product is priced higher but has a longer and trouble-free life cycle that should be preferred over lowest cost (IEEMA and Das Interview, March 2013).

Thus a product’s primary end-users can powerfully shape its prospects for upgrading. In this case, where public parastatals and power companies dominate, the government could leverage its presence strategically, as a demanding buyer, to foster innovation and help raise standards in the industry, rather than keeping them down.

#### *4.2. Policy Costs: Land Acquisition, Coal-Linkages, Inverted Duty Structure, Taxation and Infrastructure*

It is striking that in the face of vast demand – which has to be met by imports because domestic capacity cannot keep up with it – there are currently tremendous unused capacities in the electrical machinery sector (IEEMA Interview, BHEL Interview March 2013). This under-utilization of capacity is due to a slowdown in the expansion of the domestic power sector, a slowdown that is serious enough to have pushed domestic equipment suppliers to look towards export markets, alongside rising pressure of imports from China (BHEL Interview, March 2013).

The power sector slowdown, according to the firms we interviewed, is on account of set of policy issues related to land acquisition, environmental clearance procedures and the government’s coal-linkages policy that have delayed companies’ expansion plans, suspended already commissioned operations and in some cases disrupted ongoing operations. Land

acquisition problems have put several new power projects on hold, caused other plants to postpone capacity expansions and these have adversely impacted the orders of firms in the electrical machinery sector. Several other projects have been delayed due to complications with environmental clearances. Similarly coal shortages and the inability of many thermal power projects to get on to the government's coal linkage<sup>23</sup> list have produced the same outcome – of delaying power projects and affecting orders for machinery and equipment makers. As recently as April 2013, the Coal Ministry said that due to coal shortages it would not be able to meet the coal demand of several 16,000 MW power plants that were planning to come on board in 2014-15 as it was already committed to honoring 143 coal-linkage commitments for larger power plants (60,000MW and higher) during the 12<sup>th</sup> Plan (PTI April 10, 2013). As a General Manager at BHEL put it, these issues slow down production in the power sector, and consequently demand for products produced by BHEL suffers. “Policies like land acquisition and coal linkages seriously affect BHEL's order books,” and they hit private sector companies even harder (BHEL Interview, April 2013).

High costs of land acquisition, along with high levels of taxation, lack of reliable power supply rising input costs as well as a lack of local capabilities have pushed firms in several sectors to locate plants overseas. A leading automotive company that has among the highest market shares in the country spoke about their growing overseas investments. “Just within the last decade, land prices in India have increased ten-fold and the cost of energy and inputs has tripled.” Potential high quality steel projects (inputs that can help make cars lighter) like POSCO are still in limbo. “High levels of excise duties and cascading taxation policies hinder [our] competitiveness. With excise duties, VAT and octroi, a small car is taxed at 53 per cent and a larger one at 83 per cent -- charges that are approximately equivalent to tobacco taxes.<sup>24</sup> This consistent inflation of cost has forced [us] to set up plants in countries such as Poland, the Czech Republic, Vietnam, Turkey, Thailand, Indonesia and China where land and energy prices are relatively cheaper (Maruti Suzuki Interview, April 2013). Maruti Suzuki's other plants are in Japan and Pakistan.

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<sup>23</sup> The government's coal-linkages policy aims to manage industrial demand for coal by linking coal-consuming sectors with supply from coalfields spread across the country so as to ensure uninterrupted (and subsidized) supplies to core (as well as non-core) industrial sectors such as power, steel and so on. In recent years, as India was preparing for massive jumps in power generation capacity for which power plants would need coal and, since Coal India was not able to expand production to meet anticipated demand, the government decided to bring the private sector into coal production. As a consequence coal blocs were to be allocated not only to power plants but also to iron and steel firms so that they could meet their energy needs through captive plants. Coal auctions were held and coal blocs were allocated. But recent audits pointed to a misallocation of blocs on a discretionary basis. The Supreme Court therefore ordered cancellation of the blocs. Since then this sector has been troubled. Besides, this sector also has to deal with issues relating to environmental clearances (as most mines are located in the forest and tribal land) and the pricing of coal. All this has led to overall shortage of coal in the country and as a consequence expansions in the power sector as well as in other industries have been affected. The issue has become further complicated by recent court decisions in late 2014 and it remains to be seen how things are resolved.

<sup>24</sup> Apart from taxes, the absence of good infrastructure, lack of reliable power supply, high cost of land, and an unstable policy environment have undermined manufacturing performance (Maruti interview, April 2013).

A third issue concerned the inverted duty structure in the sector that firms believed hampered component imports and militated against the localization of the value chain. Several firms felt that the imports of finished products had “increased by leaps and bounds” over components imports after recent FTAs were signed with ASEAN, Korea and Thailand for example. This they argue is primarily because duties on final goods have come down to zero or near zero levels post the FTAs, while some inputs carry relatively higher duties (compared to this, in the auto sector, imports of finished cars carry 60-70 per cent duties). Others pointed out that even though electronics components are supposed to have zero duty under the WTO enforced ITA-I agreement, quite a number of the same inputs in fact attract import duties of 5-10 per cent for consumer electronics (mimeo, ELCINA Electronic Industries Association of India Pre-Budget Recommendations, 2013-14). In a survey carried out in August 2012 the Federation of Indian Chambers of Commerce and Industry (FICCI) found that seven product areas were strongly impacted by the inverted duty structure: pumps, tyres, electronic hardware, electrical equipment, medical devices/instruments, aluminum and articles thereof and technical textiles (FICCI 2012).

Under these conditions, “it makes business sense to import final goods and sell them here rather than produce them locally” (CEAMA interview, April 2013). According to this respondent, imports such as this neither create the linkages with global production networks that help you learn nor foster the creation of domestic capacities. They simply encourage trading companies (importers) to set up shop. Firms feel that the lack of scrutiny over whether rules of origin are actually being followed in context of the various FTAs that the government has signed exacerbates this problem. Given that the component base is already weak in India, and the inverted duty structure further undermines the development of local capabilities, the industry associations (e.g., CEAMA) have protested against this to the government, but so far with little success. From the interviews we conducted, it is unclear what other factors might be at play here but the point was echoed by several respondents in the electronics sector. The Chemical industry had the same lament about inverted duty structure.

Other factors named by firms that add to production costs include high landed costs, poor infrastructure, high interest rates, high transactions costs (“every interaction with the government adds to your costs”) and high costs of serviced land. As one respondent said, the logistics costs of moving goods from Delhi to Mumbai, Kolkata or Chennai is so high (due to “numerous checkpoints, poor infrastructure, high transactions costs”) that it is easier to bring in the goods from Thailand” (Khanna Interview, March 2013).

The government is well aware of these ‘policy costs’ and how high interest rates, bad infrastructure, and the problems of port congestion and so on restrict manufacturing growth in India. But some officials counter that part of the problem also is that many firms are “happy with the status-quo and not interested in doing something new.” They argue that the domestic market is large and moving beyond it requires taking risks which many are averse to. “Most companies are interested in business returns of 5-10-15 per cent, and the large domestic market allows them to get those returns with whatever they are doing” (Interview

April 16, 2013). Pointing to the success of the automotive and auto parts sector they argue that stagnation is not inevitable and these bottlenecks can be gotten around. Even so, the government is focused on introducing new plans, policies and incentives to break the infrastructure bottlenecks and ease other supply side constraints in the 12<sup>th</sup> Plan (Interview, April 2013).

#### *4.3. Market Making Role of Standards, and the Domino Effect of Missing Input Markets*

It was not surprising to find in our interviews that India's parts and components imports are of higher value and technology than its exports. What was surprising, however, was to learn that a lot of parts and components for which technology may be available domestically, but local production has not taken off either because key ancillary processes such as hardware, electronics controls do not exist locally, or for which domestic demand is not large enough for a variety of reasons, to localize manufacturing at economically viable scales. What are the conditions under which these missing linkages can be induced?

Many firms gave examples of instances where imports occur even in low to mid-tech products because only partial capabilities exist in India. One firm gave the example of anti-lock brakes with embedded IT, an important automotive component. Even though the IT capabilities and a fair amount of the technical know-how for making antilock brakes are available in India, they are imported because hardware capabilities are absent in India. Ironically, companies that import these brakes, such as Bosch, develop their software programs for the antilock brakes in India but assemble the component outside the country (Germany) and re-sell it back to India. This is because there is virtually no hardware sector in India where this can be done locally (Maruti Interview, April 2013). It is the same story for other components involving embedded IT, electronic controls and precision manufacturing (Ministry interview, April 2013). Given the fast moving nature of innovations in some industries, such as electronics, where product development and technical change is rapid, these deficits can harden into technical stagnation that can ultimately lead to deindustrialization as catch-up becomes harder to achieve.

As FTAs bind economies ever closer together by removing duties and tariffs, the entire trajectory of industrial upgrading can quickly change. For example, in the case of air-conditioners, compressors are currently imported from Korea. A decade or so ago even compressors were made locally, but as tariffs fell and 100 per cent FDI was allowed, instead of upgrading to the new generation of higher quality compressors, firms found it cheaper to import these components from Korea. The recent FTAs have reinforced this trend in numerous sectors, ranging from autos to consumer durables, electronics and machine tools (Ministry interview April 2013). The auto industry seems especially concerned about the EU-India FTA fearing it will "drive away business from India as European manufacturers would prefer to export cars than setting up plants in India. "Peugeot has already pulled out its investment from India in anticipation of a future FTA between India and the EU" (Maruti Interview, April 2013).

This pattern is particularly pronounced in the capital goods and machine tool sector where, according to the association, IMTA, a number of large firms shut shop in the 2000s once the various zero duty FTAs were signed with Japan and Korea and imports became liberalized because “it was cheaper, more reliable and faster to import rather than manufacture domestically (IMTA Interview, March 2013). As one respondent put it, “it is easier to get a CNC machine from China in 15 days but for Indian manufacturers it is hard to supply it even in a month” (Das interview, March 2013). As a result, even in the conventional and mid-level machine tool segment where India is supposed to be quite competitive, imports have doubled from 30 per cent in the late 1990s to over 60 per cent today. Of course the entire precision tooling product space is vacant in India, and “no significant foreign firm has set up manufacturing in India [in this product space]...because import duties are low (around 7.5 per cent), and inclusive of transportation costs, it is cheaper to import than manufacture in India” (Das Interview, March 2013).

The problem here is not that imports have increased as a result of various FTAs. Rising imports by themselves are not a problem. As Milberg and others point out, this is to be expected in the early stages of development of a sector (Milberg et. al 2013). The issue rather is what the imports lead to. Do they lead to the creation of domestic capabilities and upgrading within national production networks? The problem in the cases described above is that the technical spillovers from imports into the domestic economy have not materialized. From the point of view of upgrading, firms pointed out that spillovers from imports have not taken place because of two reasons. First, that the local linkages to other sectors and capabilities that are needed (high quality materials, plastics, intermediates, processes, electronics hardware) are not there or are too fragmented and expensive because the scales do not exist. And second, the demand for higher quality goods and processes is not large enough to allow the necessary scales to emerge and the backward and forward linkages to properly take root.

Several firms pointed to the role of policy in bridging this gap. First, they pointed to the example of China where imports are large, but industrial policy is strategic. Imports are strong and cheap in areas where local capability is absent, but these are quickly linked to licensing requirements as local capabilities begin to develop, which in turn are nurtured by strong performance standards, and incentives for upgrading (even within joint ventures) and supported by financial resources (low interest credit) as well as risk-mitigation strategies such as insurance (Das Interview, March 2013, ACMA interview, April 2013).

Second they pointed to the important role of “market-making” strategies such as higher and more stringent technical standards and mandates that can generate greater local demand for higher quality products and services creating the conditions for upgrading up and down the chain. For example, BHEL manufactures high tech transformers in India, a critical component for the power sector. Currently it imports a large proportion of the high tech inputs that go into the transformer from Korea, Japan, and the US. These include: wafers, a variety of electronic components, plates and tubes beyond a certain thickness and size, casting and forging beyond a certain weight and most importantly CRGO, or a special kind of



electrical steel which is used in the lamination of the transformer. This input alone constitutes more than 50 per cent of the value of the raw materials used in the transformer. The technology is highly complex and only a few global suppliers supply it (Japan, US, Russia, Germany and Italy, and China produces CRGO mostly for domestic consumption). The Ministry of Steel is aggressively trying to get SAIL India to produce it domestically, but it has not yet happened.

One solution could be for the government and industry to join hands in making high quality transformers mandatory throughout the power sector and standardize their use through product certifications. This could create the needed threshold in the domestic demand for *higher quality inputs* and processes that could encourage the localization of more advanced manufacturing processes and intermediates of higher technical standards. This might create a market for high quality components, making it feasible to find entrepreneurs willing to make the capital investments to even create CRGO domestically like China. Or, the government could take the lead in establishing partnerships with private industry or providing them patient capital to localize key inputs and materials. In a hopeful development in 2013, such partnerships seem to have emerged. The government's National Metallurgical Laboratory(NML) and the private sector company Tata Steel are proposing a joint venture for the development of CRGO steel in the country through a pilot plant setup at a cost of Rs 500 crore (US\$91 million) that is set to take off soon. Similarly, SAIL and another public sector unit in the steel sector RINL, are also planning to set up a CRGO project.

Some power distribution companies echo this point about the importance of higher product standards that can cascade up the value chain. The CEO of a major distributor noted how they had done a nationwide survey of electricity use and found essentially four kinds of main uses: (i) lighting, (ii) cooling or heating, (iii) pumping, and (iv) traction, drives or other industrial uses. And within these, they found that 50 per cent of the usage was for pumping. "The pumping load becomes the bulk of your load. There are two crore [20 million] pumpsets in the country, each approximately of 3.5 kilowatt on average, so that is 70,000 MW right there. In the rural areas farmers use them, in urban areas people use them to get water to their overhead and underground tanks, to pump gas at gas stations; industries use them. Everywhere we have pumps....and they are the most inefficient devices we know of. No capacitors, no standards, no quality" (Narayan, February 19, 2013). Just by imposing higher technical standards and quality mandates, enormous efficiency gains could be achieved and the demand would be large enough to create a market for higher quality equipment.

#### *4.4. Upgrading within Global Production Networks*

A common theme that emerged from our interviews with government officials was the concern about upgrading within global production networks. The general discomfort with participating in global production networks and value chains was the fear that firms from low income countries can get easily trapped at the bottom global value chains while higher value production, profits, technologies remains in the hands of lead firms from advanced economies who drive these chains (Ministry interviews, March and April 2013). So what are the

conditions under which economic upgrading can occur in value chains, in the face of intensified global competition from low and high cost players?

A striking example of the challenges of upgrading in global value chains and how it may occur comes from the automotive industry – a sector that has a better record of performance than many others and one that is much more inserted in global production networks than other sectors we interviewed. About a decade ago a leading domestic components supplier, the TVS group's Sundaram Fasteners Ltd. (SF) became the preferred supplier of high tensile radiator caps for General Motors' (GM's) global platform. SF set up a separate dedicated plant for the caps and established a Just-in-Time supply chain from India to the US. Within a short time it went on to win nearly 80 per cent of GM's global business in high tensile radiator caps (of a certain size) and won "Supplier of the Year" awards from GM five years in a row. The component they supplied was no doubt a low value, non-critical part, costing \$0.86 per unit, but it was very significant that this contract made SF one of the first Indian auto-component suppliers to successfully penetrate a leading manufacturer's global supply platform, and it generated a lot of learning for the company (G.P. interview, March 2013). However, this changed in 2011. Just as SF was negotiating with GM to revise the price of the caps they produced up to \$1.03, given rising input and production costs, they were outbid by a global competitor who was able to supply the same part to GM for \$0.43, or 60 per cent less than the cost SF was quoting. By the end of 2011, SF's orders fell to less than a third of previous levels (Sundaram Fasteners interview, March 2013).

The surprise was that SF was outbid on price not by a lower cost manufacturer from China, Vietnam or some other low-cost emerging economy, but by an Austrian firm. The Austrian company, which entered into the radiator cap business in 2010 in the wake of the recession in Europe, was able to supply the caps at less than half the cost of SF because it had opted for a fully automated production process. This generated a lower cost product of greater precision, more consistent quality and shorter turn-around times (Sundaram Fasteners interview, March 2013). By contrast, SF had been struggling with delays and higher input and production costs due to a range of factors. Sixty per cent of the value of their product is outsourced to small and medium sized producers in Tamil Nadu. Given the dismal power situation in Tamil Nadu where power supply to industry is available only for a few hours a day, firms routinely have to rely on costly back-up generators. Though it adds to costs, for larger firms generators or captive power plants have become a routine investment. But for many of SF's smaller suppliers who have to borrow at high interest rates to invest in back-up generation, the costs are too high. The worsening power problem, escalating input costs and high interest rates had combined to drive up SF's costs, and ironically it lost out on a relatively low-value component to a high-wage competitor.

When asked how SF had responded, the company said it had found substitute global buyers for now (Ford), gotten alternative orders for other parts from GM, but eventually would have to find ways to cut costs to compete with the Austrian firm. Two years after the shock of loss, and a wide-ranging analysis of their situation, the company had come to the conclusion that it would have to compete by also automating. Given the high capital cost of the

multiform precision equipment required to produce the caps with 100 per cent automation, India's high interest rates would make it prohibitively expensive to automate domestically. Its plans are to set up plants outside the country to take on the Austrian competitor (Sundaram Fasteners interview, March 2013).

Many critics of global production networks and the unequal power embodied in these networks could very well point to SF's decision to get into the production of relatively low value radiator caps for lead auto assemblers (GM, Rolls Royce) as an example of how Indian firms remain trapped at the bottom of global value chains. "[Many firms] are happy with the status quo and not interested in doing something new" (Ministry interview, April 2013). At first glance that may seem like a valid observation. In an interview that one of the authors of this paper had conducted with SF in the early 2000s, when they were just getting established as GM's lead supplier of radiator caps, a similar question had been asked. Is this an example of upgrading or downgrading? The response then was that the experience had already generated knowledge about what it takes to be a first tier supplier on a global platform and consistently produce significant quantities of output global quality standards. Even if the product was simple, tremendous learning had taken place (Tewari 2005).

In the recent interview SF echoed this view. While on the face of it GM's decision to switch to the lower cost Austrian firm seems to suggest that a decade-plus buyer-supplier relationship between SF as GM's top supplier of this product came to naught as it was so easily wiped out by price. Underneath the surface however things are more complex. GM and SF still have a strong relationship and SF still supplies a third of GM's demand for radiator caps. Besides, GM exchanged information with SF about cost cutting before shifting the order and gave them time to adjust and participated in the discussions.

When it became clear that under present manufacturing conditions in India cutting costs by the order of magnitude required was not possible, GM shifted the order, but at the same time negotiated with SF to move to an alternative product: a US\$6.00 shifter. This is a more technically complex sub-assembly and although it is not a critical component, it is more advanced than the radiator cap. GM has been producing it for the past two years and is moving into other similarly higher value products. Meanwhile, other global buyers, like Ford, approached SF to supply radiator caps for them, and so SF's radiator business is still running at near full capacity. But the important point is, that GM did not simply drop SF. Instead, SF diversified, and moved up the value chain a notch, to a \$6 component instead of a \$0.86 component (Sundaram interview, March 2013). TVS as a whole has redoubled its efforts to manage logistics and the company in a more focused way through its separate dedicated logistics firm in the automotive vertical, TVS Logistics, which now has offices around the globe and has entered into key joint ventures (TVS Logistics interview, March 2013). In the wake of the crisis then, industrial upgrading, did take place and was accompanied by a deepening of the firm's place within global networks, not a withdrawal.

*Summing up:* Several insights emerge from the firm-level cases discussed above. First, the examples raise stark questions about the employment generation ability of the domestic

manufacturing sector given its current status. The 12<sup>th</sup> Plan makes job generation a priority in the manufacturing and services sectors. The SF example above, however, shows how pressures of global competition combined with a deeply disabling set of domestic institutional deficits (high interest rates, a ruinous power situation, near total lack of quality inputs, quality hardware and reliable logistics) are together pushing firms toward automation and outward investment. This push toward automation, moreover, is occurring not in high-tech, cutting edge advanced manufacturing sectors where domestic capabilities do not exist, but in relatively low value manufacturing that one assumes there is domestic capability for. If more and more firms choose this capital-intensive route to leapfrogging over domestic bottlenecks, then policy makers need to worry about where the entry level and skilled manufacturing jobs that carry the potential of a pathway toward upward mobility will come from.

Second, it points to the fact that there is competition from both the high and low end (industrial and low income countries) even in low value products with relatively low margins. Domestic producers are thus squeezed in the middle by pressure on the one hand from efficient low cost producers in countries like China, and on the other from deep pocketed competitors from advanced economies who use automation to overcome low-income economies' cost advantages. We heard about this dual competition from firms in many sectors. As one electrical machinery maker that awards a lot of overseas contracts observed about their recent experience, "Earlier China was very competitive, but now, after the recession, Europeans are quoting lower prices" (BHEL interview, April 2013). At one level however, this underscores the point that low wages do not automatically equal to cost advantages. Many other factors in the institutional and business environment, besides labor cost, interact to generating real cost advantage.<sup>25</sup> The key variable with respect to upgrading therefore is not low wages, but *costs per unit* of output (Berger 2005). The Austrian firm that outbid SF operated in a high wage context, but due to other factors, such as automation, had much lower unit costs than SF which operated in an environment where even with much lower wages, it was not possible to match its competitor's cost advantages. In light of the ongoing obsession in Indian policy circles about the rigidity of the labor market and labor cost, it was striking that in our twenty-plus interviews with firms, associations and government officials, no one, except one firm, brought up the issue of labor laws or wages as an impediment to their competitiveness. The main issue about labor that emerged was about some skill shortages and the critical need for skill development.

Third, the recent recession appears to have pushed manufacturers in advanced economies, particularly Europe, to compete in even lower tech and lower value segments down the value chain. But is also noteworthy that there is some difference here between the US and EU (and Japan) and this response to the recession is not universal. What has made European firms seek out ways to revive domestic employment including by competing in lower value segments that had been 'ceded' to lower income supplier countries. This difference relates to

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<sup>25</sup> E.g., access to key inputs, their timely supply, quality infrastructure, efficient logistics and the ease of doing business, low transactions costs.

the role of the state and industrial policy. As the varieties of capital literature points out, the institutional arrangements that govern the economy are different in different economies. Given the broad tri-partite agreements between capital, labor and government in European welfare states (continental Europe) that provide greater security to labor, industrial policies that are in place make it more difficult for firms to simply shut down or move overseas in times of crisis. As a general manager of global sales with Ford India said, “You still have significant manufacturing capacities there. Europe has much more of a manufacturing footprint than there is demand for currently and if you tracked the US in the 2008 slowdown, the amount of plants that have been shut and the speed with which they were closed in responded to the downtrend, you are not seeing that in Europe currently. Everyone forecasted terrible times for Europe for about a couple of years, but the manufacturing footprint has pretty much remained and it's not easy in Europe from workers' unions perspective to simply [shut down]; It's much more difficult” (Ford interview, March 2013).

This may explain why, even as demand for higher value goods and services shrank during the recent recession, European firms tried to find other ways to stay in business, including going after easy-to-automate low value components in mid-tech industries, instead of shutting down in response to the fall in demand (as many US firms did).<sup>26</sup> Industrial policies, therefore, are an important variable in shaping the response of firms to downturns and to boom times. In other words, despite significant global engagement and an embedding in global production networks that can expose firms to relentless competition, government policy is important in mediating the impacts of the market on the local economy. Greater global participation changes the role of the state; it does not diminish or eliminate it.

The broader points this raises is that participating in regional and/or global production networks in any meaningful way -- such that upgrading occurs and firms do not remain trapped at the base of the value chain -- requires the building of local/domestic capabilities. This requires mitigating not only supply side initiatives and fixing the many behind the border factors such as poor power and infrastructure and high interest rates, a myriad interstate taxes and so on. Equally important are *demand side factors* and policy inducements that can ratchet up production quality, standards, and deepen collaborative and competitive capabilities and learning from an institutional perspective, as the power sector cases show. In sum then, at the current time meaningful participation in global networks then requires not only strategic trade in tasks – or bundles of capabilities – but also requires linkages with a steadily growing domestic market.

## V. Conclusions

Using highly disaggregated trade data, which distinguishes between parts and components, and assembled end products, we find that there is evidence of a steady growth in India's

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<sup>26</sup> An important recent literature links this to issues of financialization and the role of shareholders and the stock market in structuring the profitability and investment horizons of firms, especially in the US (Milberg 2012, Batt and Appelbaum 2013).

integration with global production networks. India's intermediates exports grew much faster (25 per cent per year) than its aggregate manufactured exports (18 per cent per year) during the ten year period we studied, and India's share of 'network' exports (assembled end products) doubled during this period. Imports showed a similar trend. By 2011 parts and components comprised 65 per cent of India's manufactured imports (up from 54 per cent in 2000), and 58 per cent of its manufactured exports. India's engagement with ASEAN grew at a faster pace than multilateral trade during this period, led by exports, which grew at an impressive 35 per cent a year (relative to 29 per cent a year for the world) during this period.

However, Indian exports to ASEAN show an increasing bias in favor of final goods (including assembled goods) rather than parts and components. The data also indicate shifts in the structure of India's exports with a growing bias towards more capital intensive and natural-resource intensive products (machinery, transport equipment, and instruments; and chemicals, metal and rubber respectively) at the expense of traditional, labor-intensive manufactured exports. The skill composition of India's exports reflects a similar dominance of capital intensive intermediate and network exports from India. Both human capital-intensive and technology-intensive exports increased their shares, with technology-intensive product shares rising faster. By contrast, the shares of natural-resource intensive and unskilled labor-intensive products declined significantly. This has important implications for the employment elasticity of India's emerging export patterns, a worrisome trend given the large projected increases in working age youth that will be added to the labor market in the coming decades.

While India's engagement with ASEAN has increased significantly in the last ten years and its market share in ASEAN has grown, is India supplying in categories that are important to ASEAN? We found that India's shares in almost all categories related to machinery, transport equipment, and scientific equipment (Category I in our scheme) are considerably lower than ASEAN's corresponding import shares from the world. By contrast, India's shares are higher than world shares for products grouped under Category III (Chemicals), particularly in 'Organic Chemicals' (HS 29). This suggests that India has significant potential to expand its ASEAN export share in the machinery sector, while also building on its existing strength in the chemicals sector to expand more fully in the ASEAN market.

Overall, A crucial finding, however, is that India has been a fast growing market from the point of view of ASEAN's exports, and vice versa. There is significant potential for growth in India's insertion in production networks in ASEAN by expanding its intermediates exports in the machinery sector, building on its strong performance in the chemicals sector by expanding the export of higher value specialty chemicals, and in general attempting to move up the value chain in the parts, components and assembled goods exported in the (electrical and non-electrical) machinery, telecommunications and transport equipment product categories. There is tremendous underexploited potential for growth in electronics and related equipment categories (HS 85). The data also suggest that there is significant potential for India to expand assembly related export activities in certain categories of network products, such as electrical machinery (SITC 77), professional and scientific equipment (SITC 87),

telecommunications and sound recording equipment (SITC 76), office machines and automatic data processing machines (SITC 75) and of course road vehicles (SITC 78).

Our field level interviews with firms, industry associations and policy makers bore out some of these emerging trends. Our interviews show that primarily Indian firms are relatively less integrated in global production networks because of their focus on the large domestic market over exports. Still, firms do see East Asia and ASEAN as important export destinations, as well as a source for technology intensive imports. However, despite the growth of some key sectors such as road vehicles and electrical machinery and chemicals, there is very little value addition in Indian manufacturing. This translates into low-value exports and a high degree of dependence on expensive imports.

Major impediments to the evolution of both manufactured exports as well as the localization of higher value domestic capabilities include: sub-optimal scales of production in key intermediate sectors, a near total lack of quality inputs (high quality steel, electronics, quality plastics), precision and high quality tooling, the complete absence of the electronics hardware sector (including semiconductor devices), and the lack of serious R&D or skill development. The fact that public sector companies and utilities are the clients of many manufacturing firms has also kept innovation down because of low technical standards. These structural deficits are compounded by policy costs imposed on firms by the disabling lack of reliable power supply, inadequate infrastructure and logistics, high interest rates, weak capital markets, high price of land as well as high costs of land acquisition and an unstable policy environment. One leading automotive assembler who also leads in exports said that the shortage of power and infrastructure alone had escalated their cost of doing business by 15-20 per cent. Although firms have found ways to cope, the costs are high and many are circumventing these bottlenecks by resorting to automation and turning toward expansion and investment overseas. This is taking place through technology acquisitions as well as setting up off-shore manufacturing plants. Both these trends have worrisome implications for domestic job creation.

In sum, then, participation in global networks is not a panacea, nor a fetish that must be pushed for its own sake. These global arrangements have externalities and outcomes associated with them that can carry risks as well as opportunities. The state therefore cannot be absent from the management of these relationships between domestic firms, and the domestic policy environment and international production and financial networks. At minimum this role involves creating incentives and opportunities to rise within value chains, as our examples of standards and policy inducements suggested and build supportive institutions. More broadly it involves engaging creatively with the uncertainties and ambiguities in the competitive environment to create an institutional milieu where continuous learning can occur and adaptive skills can be formed in the context of “managed” engagement with fast moving international networks.

The larger point then is that upgrading within regional production networks requires domestic capability formation. This calls for not only mitigating supply side bottlenecks and

addressing behind the border problems, but also paying attention to demand side factors and policy inducements that can ratchet up production quality, standards, deepen collaborative and competitive capabilities and generate learning so as to create the conditions for upgrading in an institutional context of production sharing.

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## VII Appendix: Tables and Figures

Table 1: Number of 6-digit HS Codes Corresponding to Different Product Groups

	SITC Codes	BEC Codes	No. of HS 6-digit codes
All products (SITC 1 to 9)	1 to 9		5017
Manufacturing	5+ 6+ 7+ 8		4185
Parts and components, all products	1 to 9	22 + 42+ 53+ 121+ 322	2716
Parts and components, manufacturing	5+ 6+ 7+ 8	22 + 42+ 53 + 121+322	2518
Network products	75 + 76+ 77+ 78+ 87+ 88		576
Parts and Components, network products	75 + 76+ 77+ 78+ 87+ 88	22 + 42+ 53	241

Table 2: Average Annual Growth Rates of Trade, 2000-2011

	Multilateral Trade				India's Bilateral Trade with ASEAN	
	ASEAN		India		Exports	Imports
	Exports	Imports	Exports	Imports		
Manufactured Products, All	8.7	9.5	17.7	23.8	20.9	20.6
Manufactured Products, Parts and Components	9.3	9.2	17.6	25.9	17.4	20.2
Manufactured Products, End Products	7.7	10.2	17.7	20.7	28.5	21.4
Network Products, All	5.7	6.5	24.8	23.5	23.8	17.0
Network Products, Parts and Components	5.8	5.5	20.1	21.8	13.7	14.9
Network Products, Assembled Products	5.3	9.2	29.1	25.2	34.6	19.3

Note: (i) Growth rates are calculated using semi-logarithmic regressions

Source: Estimated from COMTRADE-WITS database

Table 3: Percentage Share of Network Products in India's Total Exports of Manufactured Products to the World ( per cent)

	Parts & components			Assembled products			Total		
	2000/01	2004/05	2010/11	2000/01	2004/05	2010/11	2000/01	2004/05	2010/11
Office machines and automatic data processing machines (SITC 75)	0.57	0.38	0.15	0.64	0.48	0.59	1.21	0.87	0.74
Telecommunication and sound recording equipment (SITC 76)	0.07	0.10	0.41	0.28	0.31	1.78	0.35	0.41	2.19
Electrical machinery (SITC 77)	1.58	1.71	2.25	0.79	0.93	0.97	2.38	2.65	3.22
Road vehicles (SITC 78)	1.50	1.66	1.68	0.88	2.17	3.61	2.39	3.83	5.29
Professional and scientific equipment (SITC 87)	0.13	0.12	0.26	0.30	0.36	0.43	0.43	0.48	0.69
Photographic apparatus (SITC 88)	0.15	0.13	0.06	0.14	0.09	0.03	0.30	0.22	0.09
Total Network Products	4.01	4.10	4.80	3.04	4.34	7.41	7.05	8.44	12.22

Note: These shares are averages for the given two years.

Table 4: India's exports of Intermediate Manufactured Products to the World (Top 20 Product Groups)

Product Code	Product Description	India x to World					
		2000-01	2004-05	2010-11	2000-01	2004-05	2010-11
I	<b>Machinery, Transport Equipment and Scientific Instruments</b>	Value (US \$ millions)			per cent share		
	84 Nuclear reactors, boilers, mchy & m	506885	1497903	4295950	2.8	4.1	4.6
	85 Electrical mchy equip parts thereof	774583	1248937	4261993	4.3	3.4	4.6
87	Vehicles o/t railw/tramw roll-stock	480750	1069756	2711953	2.7	2.9	2.9
II	<b>Basic Metals and Products</b>						
	72 Iron and steel.	1044615	3910977	7449090	5.9	10.8	8.1
	73 Articles of iron or steel.	647324	1924374	5692715	3.6	5.3	6.2

74	Copper and articles thereof.	150258	1047212	4141717	0.8	2.9	4.5
76	Aluminium and articles thereof.	277158	488348	1267431	1.6	1.3	1.4
79	Zinc and articles thereof.	4717	35994	729697	0.0	0.1	0.8
<b>III</b>	<b>Chemicals</b>						
29	Organic chemicals.	1620793	3864108	9869301	9.1	10.6	10.7
28	Inorgn chem; compds of prec mtl, r	201666	347549	1038801	1.1	1.0	1.1
32	Tanning/dyeing extract; tannins &	504405	751696	1756165	2.8	2.1	1.9
38	Miscellaneous chemical products.	163506	302714	930482	0.9	0.8	1.0
30	Pharmaceutical products.	246764	374276	1046964	1.4	1.0	1.1
<b>IV</b>	<b>Plastics and Rubber</b>						
39	Plastics and articles thereof.	609559	1905343	4104410	3.4	5.2	4.4
40	Rubber and articles thereof.	303881	682072	1797853	1.7	1.9	1.9
<b>V</b>	<b>Other products</b>						
71	Natural/cultured pearls, prec stone	6386487	10724988	27619522	35.9	29.5	29.9
54	Man-made filaments.	505440	954430	2411800	2.8	2.6	2.6
52	Cotton.	951555	1018058	2173906	5.3	2.8	2.3
55	Man-made staple fibres.	419381	696358	1425362	2.4	1.9	1.5
68	Art of stone, plaster, cement, asbe	299469	505259	1001569	1.7	1.4	1.1
	Total	16099196	33350352	85726681	90.2	91.6	92.6
	Grand Total	17808437	36356513	92517082	100	100	100

Table 5: India's Imports of Intermediate Manufactured Products from the World (Top 20 Product Groups)

Product Code	Product Description	World exports to India					
		2000-01	2004-05	2010-11	2000-01	2004-05	2010-11
<b>I</b>	<b>Machinery, Transport Equipment and Scientific Instruments</b>	Value (US \$ millions)			per cent share		
84	Nuclear reactors, boilers, mchy & m	1945008	3542778	13807623	11.6	9.1	12.2
85	Electrical mchy equip parts thereof	1765426	3530959	10951745	10.6	9.0	9.7
87	Vehicles o/t railw/tramw roll-stock	420459	1004673	4152321	2.5	2.6	3.7
90	Optical, photo, cine, meas, checkin	348819	540399	1272270	2.1	1.4	1.1
<b>II</b>	<b>Basic Metals and Products</b>						
72	Iron and steel.	627216	2674321	8594728	3.8	6.8	7.6
73	Articles of iron or steel.	302428	1059980	4082351	1.8	2.7	3.6
76	Aluminium and articles thereof.	126104	375354	1353973	0.8	1.0	1.2
74	Copper and articles thereof.	128190	438651	1103690	0.8	1.1	1.0
<b>III</b>	<b>Chemicals</b>						
29	Organic chemicals.	1633304	3823571	11059727	9.8	9.8	9.8
31	Fertilisers.	326778	805638	8304806	2.0	2.1	7.3
28	Inorgn chem; compds of prec mtl, r	675369	1586260	3243637	4.0	4.1	2.9
38	Miscellaneous chemical products.	372438	693380	2185606	2.2	1.8	1.9

32	Tanning/dyeing extract; tannins &	236303	487494	1162032	1.4	1.2	1.0
30	Pharmaceutical products.	109291	208072	735443	0.7	0.5	0.6
<b>IV</b>	<b>Plastics and Rubber</b>						
39	Plastics and articles thereof.	632341	1766736	5947310	3.8	4.5	5.2
40	Rubber and articles thereof.	117821	241575	1037741	0.7	0.6	0.9
<b>V</b>	<b>Other products</b>						
71	Natural/cultured pearls, prec stone	4669126	11460725	22682411	28.0	29.3	20.0
48	Paper & paperboard; art of paper pu	267422	480624	1160504	1.6	1.2	1.0
59	Impregnated, coated, cover/laminate	126441	358828	1010540	0.8	0.9	0.9
54	Man-made filaments.	239431	509079	833351	1.4	1.3	0.7
	Total	15069715	35589097	104681809	90.4	91	92.3
	Grand Total	16695379	39055633	113363719	100	100	100

Table 6: Percentage Share of Network Products in India's Total Exports of Manufactured Products to ASEAN (per cent)

	Parts & components			Assembled products			Total		
	2000/ 01	2004/ 05	2010/ 11	2000/ 01	2004/ 05	2010/ 11	2000/ 01	2004/ 05	2010/ 11
Office machines and automatic data processing machines (SITC 75)	6.49	1.28	0.47	1.31	0.66	0.90	7.79	1.94	1.37
Telecommunication and sound recording equipment (SITC 76)	0.17	0.11	0.12	0.37	0.24	2.40	0.54	0.35	2.53
Electrical machinery (SITC 77)	1.96	1.39	1.73	0.99	1.24	1.46	2.95	2.63	3.19
Road vehicles (SITC 78)	1.19	1.69	2.14	0.55	0.49	4.33	1.74	2.18	6.47
Professional and scientific equipment (SITC 87)	0.07	0.11	0.49	0.40	0.45	0.79	0.47	0.56	1.28
Photographic apparatus (SITC 88)	0.20	0.15	0.11	0.10	0.10	0.09	0.31	0.24	0.20
Total Network Products	10.08	4.73	5.07	3.73	3.18	9.97	13.81	7.91	15.04

Note: These shares are averages for the given two years.



Table 7: India's Exports of Intermediate Products to ASEAN (Top 20 Product Groups)

HS Code	Product Group	Values (US \$ Millions)			Percentage Shares		
		2000/01	2004/05	2010/11	2000/01	2004/05	2010/11
	<b>I Machinery, Transport Equipment and Scientific Instruments</b>						
84	Nuclear reactors, boilers	35	118	498	3	3	7
85	Electrical mchy equip parts	113	105	198	8	3	3
90	Optical, photo, cine,	4	15	95	0	0	1
87	Vehicles o/t railw/tramw	26	92	283	2	2	4
	<b>II Basic Metals and Products</b>						
72	Iron and steel.	107	486	521	8	13	8
74	Copper and articles thereof.	13	225	376	1	6	6
76	Aluminium and articles	124	154	286	9	4	4
79	Zinc and articles thereof.	0	4	228	0	0	3
73	Articles of iron or steel.	37	69	225	3	2	3
	<b>III Chemicals</b>						
29	Organic chemicals.	168	621	1389	13	16	21
38	Miscellaneous chemicals	24	65	181	2	2	3
32	Tanning/dyeing extract	42	68	174	3	2	3
28	Inorgn chemicals	25	75	160	2	2	2
	<b>IV Plastics and Rubber</b>						
39	Plastics and articles thereof.	72	159	316	5	4	5
40	Rubber and articles thereof.	35	56	213	3	1	3
	<b>V Other Products</b>						
71	Natural/cultured pearls	306	1151	723	23	30	11
54	Man-made filaments.	50	108	152	4	3	2
52	Cotton.	33	35	89	2	1	1
30	Pharmaceutical products.	15	18	75	1	0	1
55	Man-made staple fibres.	17	25	64	1	1	1
	Total	1246	3646	6246	93	95	93
	Grand Total	1336	3843	6728	100	100	100

Table 8: India's Imports of Intermediate Products from ASEAN (Top 20 Product Groups)

HS Code	Product Group	Values (US \$ Millions)			per centage Shares		
		2000/01	2004/05	2010/11	2000/01	2004/05	2010/11
	<b>I Machinery, Transport Equipment and Scientific Instruments</b>						
85	Electrical mchy equip parts	422	622	1547	22.1	17.1	14.2
84	Nuclear reactors, boilers	156	358	1426	8.1	9.8	13.0
87	Vehicles o/t railw/tramw	35	116	353	1.8	3.2	3.2
90	Optical, photo, cine	46	89	189	2.4	2.4	1.7
	<b>II Basic Metals and Products</b>						
73	Articles of iron or steel.	22	65	304	1.1	1.8	2.8
72	Iron and steel.	25	117	294	1.3	3.2	2.7
74	Copper and articles thereof.	23	57	218	1.2	1.6	2.0
76	Aluminium and articles thereof.	28	62	206	1.5	1.7	1.9
75	Nickel and articles thereof.	31	45	188	1.6	1.2	1.7
80	Tin and articles thereof.	14	35	161	0.7	1.0	1.5
	<b>III Chemicals</b>						
29	Organic chemicals.	253	713	2256	13.2	19.6	20.6
38	Miscellaneous chemical products.	91	82	287	4.8	2.3	2.6
32	Tanning/dyeing extract; tannins	52	126	192	2.7	3.4	1.8

28	Inorganic chemicals	60	65	159	3.1	1.8	1.5
30	Pharmaceutical products.	3	4	77	0.2	0.1	0.7
<b>IV Plastics and Rubber</b>							
39	Plastics and articles thereof.	139	396	1404	7.3	10.9	12.8
40	Rubber and articles thereof.	14	35	145	0.7	1.0	1.3
<b>V Other Products</b>							
49	Printed books, newspapers	34	84	343	1.8	2.3	3.1
71	Natural/cultured pearls	86	46	236	4.5	1.3	2.2
54	Man-made filaments.	118	153	113	6.2	4.2	1.0
	Total	1651	3270	10098	86.4	89.7	92.4
	Grand Total	1911	3644	10933	100	100	100

Table 9: ASEAN's Export Intensity in Indian Market

		$S_{aw}$	$EI_1$			$EI_2$		
			2010/11	2000/01	2004/05	2010/11	2000/01	2004/05
<b>I</b>	<b>Machinery, Transport Equipment and Scientific Instruments</b>							
85	Electrical mchy equip parts	23.1	2.1	1.9	1.5	0.4	0.5	0.6
84	Nuclear reactors, boilers	11.8	0.7	1.1	1.1	1.7	1.3	1.1
87	Vehicles o/t railw/tramw	3.8	0.7	1.2	0.9	1.0	1.0	0.9
90	Optical, photo, cine, meas	3.3	1.1	1.8	1.5	1.1	0.9	0.5
<b>II</b>	<b>Basic Metals and Products</b>							
73	Articles of iron or steel.	3.6	0.6	0.7	0.8	0.6	0.6	0.8
74	Copper and articles thereof.	2.8	1.5	1.4	2.0	0.9	0.9	0.7
72	Iron and steel.	2.4	0.4	0.5	0.4	1.1	1.3	1.1
80	Tin and articles thereof.	1.6	5.7	8.2	8.8	1.3	0.9	0.9
76	Aluminium and articles thereof.	1.4	2.0	1.8	1.6	1.5	1.4	1.4
82	Tool, implement, cutlery, spoon	0.5	1.0	1.6	1.7	1.6	1.6	1.4
<b>III</b>	<b>Chemicals</b>							
29	Organic chemicals.	10.9	1.4	2.0	2.1	2.4	1.8	1.9
38	Miscellaneous chemicals	2.8	2.1	1.3	1.4	3.1	1.2	0.9
32	Tanning/dyeing extract	0.9	1.9	2.8	1.7	2.4	2.9	1.9
28	Inorgn chemicals	0.9	0.8	0.4	0.5	6.7	2.9	1.6
30	Pharmaceutical products.	0.6	0.2	0.2	1.1	0.8	0.4	1.2
33	Essential oils & resinoids	0.6	1.1	1.2	2.6	1.2	0.8	0.7
34	Soap, organic surface-active	0.5	0.7	1.2	1.5	1.2	1.2	1.0
<b>IV</b>	<b>Plastics and Rubber</b>							
39	Plastics and articles thereof.	10.6	1.9	2.4	2.4	1.1	1.2	1.2
40	Rubber and articles thereof.	4.3	1.0	1.5	1.5	0.4	0.4	0.3
<b>V</b>	<b>Other Products</b>							
44	Wood and articles of wood	1.7	4.7	2.1	4.4	0.2	0.1	0.4
49	Printed books, newspapers	1.4	5.0	4.8	7.4	11.2	13.4	2.2
54	Man-made filaments.	1.2	4.3	3.2	1.4	3.2	2.8	0.9
71	Natural/cultured pearls	1.1	0.2	0.0	0.1	5.4	1.0	2.0
55	Man-made staple fibres.	1.0	1.9	1.5	1.1	0.3	0.3	0.3

70	Glass and glassware.	1.0	<b>1.7</b>	<b>2.0</b>	<b>0.9</b>	<b>1.9</b>	<b>1.5</b>	<b>0.5</b>
48	Paper & paperboard	0.9	<b>1.1</b>	<b>0.9</b>	<b>0.6</b>	<b>1.4</b>	<b>1.6</b>	<b>0.7</b>

Table 10: Trends and Patterns of Intra-Industry Trade (Grubel Lloyd Indices, Weighted Averages)

HS codes		2000			2005			2011		
		IIT	HIIT	VIIT	IIT	HIIT	VIIT	IIT	HIIT	VIIT
<b>I</b>	<b>Machinery, Transport Equipment and Scientific Instruments</b>									
85	Electrical mchy equip parts	0.15	0.03	0.12	0.20	0.07	0.13	0.21	0.03	0.18
84	Nuclear reactors, boilers	0.44	0.00	0.44	0.20	0.07	0.13	0.42	0.06	0.35
87	Vehicles o/t railw/tramw	0.27	0.00	0.27	0.64	0.01	0.63	0.74	0.00	0.74
88	Aircraft, spacecraft and parts	0.94	0.00	0.94	0.03	0.00	0.03	0.68	0.00	0.68
90	Optical, photo, cine, meas	0.18	0.01	0.17	0.29	0.03	0.26	0.68	0.04	0.64
<b>II</b>	<b>Basic Metals and Products</b>									
73	Articles of iron or steel	0.39	0.02	0.37	0.35	0.06	0.29	0.36	0.05	0.32
72	Iron and steel	0.15	0.04	0.10	0.20	0.15	0.06	0.15	0.11	0.04
76	Aluminium and articles	0.15	0.12	0.04	0.27	0.21	0.06	0.16	0.10	0.06
74	Copper and articles	0.44	0.37	0.07	0.07	0.05	0.02	0.39	0.26	0.13
79	Zinc and articles	0.01	0.00	0.01	0.19	0.16	0.04	0.05	0.05	0.00
80	Tin and articles	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00
<b>III</b>	<b>Chemicals</b>									
29	Organic chemicals	0.38	0.18	0.20	0.38	0.33	0.06	0.26	0.19	0.08
38	Misc. chemical products	0.28	0.07	0.21	0.28	0.07	0.21	0.29	0.20	0.09
28	Inorganic chemicals	0.14	0.01	0.13	0.10	0.01	0.09	0.17	0.13	0.05
32	Tanning or dyeing extracts	0.12	0.02	0.11	0.17	0.07	0.09	0.23	0.04	0.18
30	Pharmaceutical products	0.41	0.00	0.41	0.29	0.11	0.17	0.38	0.00	0.38
31	Fertilizers	0.00	0.00	0.00	0.74	0.00	0.74	0.13	0.01	0.12
33	Essential oils and resinoids	0.17	0.09	0.09	0.23	0.08	0.15	0.38	0.12	0.26
<b>IV</b>	<b>Plastics and Rubber</b>									
39	Plastics and articles	0.53	0.09	0.43	0.33	0.20	0.13	0.28	0.24	0.04
40	Rubber and articles	0.13	0.07	0.06	0.19	0.02	0.17	0.30	0.10	0.21
<b>V</b>	<b>Other Products</b>									
71	Pearls, precious stones, etc	0.11	0.00	0.11	0.03	0.00	0.03	0.26	0.22	0.05
54	Man-made filaments	0.11	0.02	0.09	0.12	0.10	0.02	0.23	0.17	0.06
48	Paper and paperboard	0.35	0.15	0.20	0.16	0.04	0.11	0.26	0.11	0.15
41	Raw hides and skins	0.39	0.01	0.38	0.29	0.09	0.20	0.21	0.20	0.01
49	Printed books and newspapers	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44	Wood and articles	0.30	0.03	0.28	0.19	0.08	0.11	0.06	0.04	0.03
52	Cotton	0.05	0.03	0.02	0.19	0.13	0.06	0.16	0.15	0.01
23	Residues and waste from food industries	0.09	0.00	0.09	0.27	0.00	0.27	0.19	0.17	0.03
	Total	0.26	0.05	0.21	0.21	0.11	0.10	0.29	0.12	0.17

Note: The table includes all 2-digit codes with a trade (export plus import) share of at least 0.05 per cent per centage in total bilateral trade between India and ASEAN in 2011.



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