The empirical measurement and determinants of intra-industry trade for a developing country

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Abstract

The analysis computed the trends and determinants of India's bilateral composite IIT as well as sectoral IIT with select trade partners. In particular, Grubel - Lloyd Corrected (Grubel and Lloyd, 1975) and Aquino (1997) indices have been used for the empirical analysis involving bilateral aggregate and bilateral sectoral IIT respectively. The empirical results provide evidence for a major part of actual IIT to be explained outside the framework of the neoclassical theories of international trade. The major findings are as follows. First, India's aggregate as well as sectoral IITs in general displayed a positive time trend with the ROW. This signifies that the country's two-way manufacturing trade in general and its IPN participation with partners in particular has considerably deepened over the period. Second, the regression analysis indicates that several demand-related (e.g., income difference), supply-oriented (e.g., technology difference), friction-led (e.g., distance, trade facilitation, contiguity, language) and sector-specific (e.g., average labour productivity, vertical product differentiation) factors display a strong statistical relationship with IIT as expected. Third, the empirical analysis strongly underlines the importance of trade facilitation measures in enhancing IIT, which needs to be viewed in a wider perspective. As presence of poor connectivity framework raises transport costs and discourage trade in parts and components (i.e., the relatively low value-added items) significantly, the two-way trade (i.e., IIT) in a wide range of manufacturing product segment can be affected. Fourth, as diversification of product baskets (i.e., product differentiation) happens to be a significant driver of IIT, there is a strong case to focus on technological innovation through research and development (R&D), for maintaining intra-sectoral manufacturing trade flows.

Keywords Trade Policy, international trade, LPI, trade facilitation, machine learning

Introduction

According to the classical trade theories, a country would specialize in export of products, which utilize the abundant factors available therein intensively. In other words, literature predicts complete specialization across industry groups. From 1960s onwards, simultaneous exports and imports within the same sectors became a regular feature of international trade. Balassa (1966) used the specific term IIT to describe this phenomenon of simultaneous trade in parts and components, semi-finished products as well as final goods, which has become increasingly important over the last decade. The empirical measurement of IIT was enriched through the early works of Grubel (1967), and Grubel and Lloyd (1975). The presence of IIT-type trade has been theoretically explained through product diversity argument and specialization in narrower product lines (Dixit and Stiglitz, 1977), effect of home market and the presence of increasing returns (Krugman, 1980; Lancaster, 1980). However simultaneous export and import among trade partners is widely prevalent across product categories.

With the inception of WTO in 1995, the Member countries significantly reformed their manufacturing tariffs, facilitating cross-border trade flows in this category. Consequently, the level of IIT between developed-developed and developed-developing countries increased, thereby deepening the IPNs in major manufacturing sectors. During the past three decades, global production sharing has led to a new form of division of labour between Asian economies, especially in East and Southeast Asia (UNESCAP, 2011). The process has been facilitated further with emergence of a number of RTAs, paving the road for growing intra-bloc IIT, e.g., cross-country trade in automobile sector involving parts and components and semi-finished products within ASEAN (WTO, 2011). Adoption of trade facilitation measures like harmonization of rules of origin (henceforth ROOs) provisions may further deepen such intra-bloc IPNs, reflected in higher IIT indices (Fukunaga and Isono, 2013).

The growing occurrence of IIT can be explained by the ongoing currents of globalization, including: tariff reforms (Diakantoni and Escaith, 2014), deepening of IPNs in major manufacturing sectors (UNESCAP, 2011), fragmentation of production blocs (Kimura and Ando, 2005), formation of newer RTAs (WTO, 2011), enhanced trade facilitation measures (Fukunaga and Isono, 2013) and industrial clustering (Djulius, 2017). In recent years, IIT in Asian countries is on the rise owing to specialization in narrower product segments, emergence of production blocks and value chain integration among manufacturing sector firms across borders and RTA-led tariff reforms (Ando, 2006; Taguchi, 2014).

India embarked on the path of the export-oriented growth model from 1991 onwards and relied primarily on export promotion as a strategy, through multilateral route up to the Cancun Ministerial (2003) meeting of WTO. Afterwards, it has entered into a number of RTAs, located both within and outside Asia. From 2005 onwards the country has entered into numerous RTAs with East, Southeast and South Asian economies, which through tariff and ROOs reforms have facilitated bilateral trade considerably (Aggarwal, 2020). The value chain integration involving Indian players has deepened across industrial sectors as a result of RTA-led reforms involving ASEAN members, Japan and South Korea as well as unilateral tariff reforms (Anukoonwattaka and Mikic, 2011; Aggarwal, 2017a; Goldar et al., 2017; Veeramani and Dhir, 2017). It has also reduced the tariff barriers significantly over the years both through the unilateral and regional reforms, paving the road for its participation in IPNs. Consequently, India's bilateral IITs with partner countries have increased over the period. In 2014, the country launched the 'Make-in-India' (henceforth MII) programme, which aims to promote exports from the country by encouraging foreign players to set up production units and transfer cutting-edge technology to India. The MII initiative is also likely to facilitate import of intermediate goods and parts and components by the foreign units in India from their network partners located in East and Southeast Asia. India's participation in the upcoming mega-RTAs, e.g., the Regional Comprehensive Economic Partnership (henceforth RCEP) is likely to enhance the ongoing process of IPN integration and in effect IIT further (Aggarwal and Chakraborty, 2020a, 2020b, 2020c). The deepening of IPNs and the consequent rise in simultaneous export and import with leading trade partners have resulted in higher bilateral IIT indices for India at aggregate level over the last decade (Aggarwal and Chakraborty, 2017, Nag et al., 2021).

The present chapter intends to analyze the determinants of India's composite as well as sectoral IIT, for seven key manufacturing categories, with major trade partners over 2001-15. The analysis is arranged along the following lines. First, a brief review of IIT literature is presented, followed by the evidence in Indian context. The empirical model and data for the analysis are explained next. Based on obtained results, policy conclusions and managerial implications are drawn.

Review of Literature

Measurement of Intra-Industry Trade

IIT measurement can be conducted with the GLU formula, used for country *j* for industry *i* as the following:

$$\text{GLU} = \frac{\sum(X_{ij} + M_{ij}) - \sum|X_{ij} - M_{ij}|}{\sum(X_{ij} + M_{ij})} \times 100$$

where, X_{ij} and M_{ij} denote the value of export and imports of the home country with country *j* at HS 4-digit level respectively (i.e., over HS 0101 to HS 9999).

The bilateral IIT, either at aggregate or the sectoral trade level, was initially measured with the GLU index. However, it was later noted that the index leads to underestimation of IIT while measuring the index between countries with dissimilar development profile, owing to the trade imbalance effect. The problem was addressed by the GLC index, which computes IIT between home country and partner country *j* with the following formula (Grubel and Lloyd, 1975):

$$\text{GLC} = \frac{\sum(X_{ij} + M_{ij}) - \sum|X_{ij} - M_{ij}|}{\sum(X_{ij} + M_{ij}) - |\sum X_{ij} - \sum M_{ij}|} \times 100 \text{ ….. (1)}$$

where, X_{ij} and M_{ij} denote the value of export and imports of the home country with partner country *j* for industry *i* (at HS 4-digit level) respectively (i.e., over HS 0101 to HS 9999).

However, subsequently it was noted that GLC might be an inefficient index for measuring sectoral IIT between countries characterized by divergent efficiency levels in manufacturing sector. For instance, suppose in electrical equipment (HS 85) trade between China and Myanmar, China enjoys trade surplus in each of the HS 4-digit headings under the product category (i.e., for all i, spanning over 8501 to 8548). Under such instances, the computed GLC index will always be 100 irrespective of the volume of trade, as the numerator and denominator in equation (1) would turn out to be the same expression. Aquino (1997) proposed the following two-step methodology to compute IIT index in presence of such trade imbalances. In the first step, estimated values of export (X_{ij}^{e}) and import (M_{ij}^{e}) of home country with partner country *j* for industry *i* are calculated as:

$$X_{ij}^{e} = X_{ij} * \frac{\sum(X_{ij} + M_{ij})}{2\sum X_{ij}}\,;\, M_{ij}^{e} = M_{ij} * \frac{\sum(X_{ij} + M_{ij})}{2\sum M_{ij}}$$

In the second step, the Aquino index for home country with country *j* for the i-th sector, i.e., electrical equipment (HS 85), is calculated in the following manner:

$$A_j = \frac{\sum(X_{ij} + M_{ij}) - \sum\left|X_{ij}^{e} - M_{ij}^{e}\right|}{\sum(X_{ij} + M_{ij})} \times 100\ldots\ldots (2)$$

Therefore, in presence of trade imbalance across all sub-sectors, the bilateral sectoral IIT is best captured with the Aquino index.

Global Evidence

A rich literature on IIT measurement has evolved over the period (Balassa, 1986; Bergstrand, 1990; Caves, 1981). While a higher level of IIT in manufacturing trade involving developed countries is generally noticed, influence of trade policies on the index is also recognized (Falvey, 1981). In the initial period the literature focused more on computation of IIT index and the methodological debates (Greenaway and Milner; 1981, 1983; Grubel and Lloyd, 1975; Aquino, 1997); measurement of composite IIT index (Greenaway and Milner, 1983; Ito and Okubo, 2012); and analyzing the determinants of IIT through cross-country panel data analysis (Lapinska, 2016; Türkcan and Ates, 2010). The results indicated that higher IIT is associated with rise in development level of both partners and higher potential for product differentiation, coupled with presence of lower trade barriers. While aggregate IIT in developing countries might be lower compared to their industrial counterparts, higher IIT indices is noticed there at sectoral level, particularly for capital-intensive products. It is observed from the extant literature that income difference, technology difference, endowment difference, FDI flows, common border and language, presence of RTA etc. are among the key explanatory variables used for explaining bilateral IIT in a panel data framework (Bhattacharyya, 2005; Lapinska, 2016; Türkcan and Ates, 2010, Aggarwal et al., 2021, 2022, 2023).

With the evolution of literature, analysis of determinates of the IIT at the sectoral level has come up as another branch of research (Clark, 1993; Loertscher and Wolter, 1980; Greenaway et al., 1995; Kaur et al., 2016). The determinant analysis at the sectoral level has been conducted both for developed (Andresen, 2003; Ito and Okubo, 2012; Marius-Răzvan and Camelia, 2015) and developing (Hu and Ma, 1999; Veeramani, 2002; Burange and Chaddha, 2008) countries. It is observed from the enduring literature that income difference, technology difference, endowment difference, FDI flows, tariff and non-tariff barriers, research and development intensity, market power, common border and language, presence of RTA etc. are among the key independent variables used for explaining bilateral IIT (indices computed at both aggregate as well as sectoral levels) in a panel data framework (Aturupane et al., 1999; Bhattacharyya, 2005; Chang, 2009; Varma and Ramakrishnan, 2014; Aggarwal and Chakraborty, 2017).

Subsequently, in the later period, the focus has evolved towards identifying qualitative differentiation of IIT patterns in sub-categories, namely, horizontal and vertical type (Abd-el-Rahman, 1991). HIIT can be defined as simultaneous export and import of products that are similar in terms of quality but have different characteristics or attributes. On the other hand, VIIT can be explained by differences in technology (e.g., capital intensity, labour productivity through skill formation) and fragmented production process (Banik and Das, 2014), where countries characterized by higher productivity and wages exports the varieties embodying higher quality (Flam and Helpman, 1987; Greenaway, Hine and Milner, 1995; Wakasugi, 2007).

Intra-Industry Trade Evidence in Indian Context

In line with the global trend, an attempt has been made for evaluating the IIT scenario in India as well. In the pre-reform period, rising trade flows in India did not result in a matching rise in IIT indices barring a few commodity groups (Pant and Barua, 1986; Kantawala, 1997). India's bilateral IIT remained low upto late nineties, a period characterized by ongoing economic reforms (particularly import tariff liberalization). The analysis of Pant and Barua (1986) over 1960-80 observed that in spite of rise in trade flows, there was no appreciable change in India's IIT indices with the exception of few product categories. Analyzing India's IIT with SAARC partners over 1981-92, Kantawala (1997) also reported low values of bilateral IIT. Considering capital goods industries, Veeramani (1999) noted marginal increase in aggregate IIT index over the years and observed that India's trade is predominantly vertical in nature. Comparing the multilateral IIT over 1987-88, 1994-95 and 1998-99 by analysing the influence of various country-specific factors on India's bilateral IIT, Veeramani (2001) arrived at a similar conclusion.

In the post-reform period, a rising trend in the aggregate as well as sectoral IIT indices were noted during 2000-09, when economic reform effects were visible, but the simultaneous trade in product categories was found to be predominantly vertical in nature (Bhattacharyya, 2002; Veeramani, 1999; Veeramani, 2001; Aggarwal, 2016; Aggarwal, 2017b). Burange and Chaddha (2008) assessed the growth in India's IIT over 1987-88 to 2005-06 at 4-digit level of HS classification across regions and attributed the rise in IIT index to the growing manufacturing trade. Banerjee and Bhattacharyya (2004) urged the importance of growing development level in the country as an essential cause for sustaining higher IIT levels.

In the post-2010 period, a number of India-centric RTAs have come up, through ROO provisions and with the resulting rise in both-way manufacturing trade, the bilateral IIT indices has also intensified (Aggarwal and Chakraborty, 2019, 2021, 2022; Kaur et al., 2016; Kumar and Ahmed, 2014). The studies conducted at HS 6-digit level indicated rising importance of both VIIT (Srivastava and Medury, 2011) and HIIT (Kelkar and Burange, 2016) for India. A few other recent studies have focused on India's IIT pattern with select partner countries / trade blocs. Kumar and Ahmed (2014) investigated the IIT between India and Bangladesh at the three-digit level of SITC, underlining a need for export diversification from Bangladesh. Kaur et al. (2016) noticed a rise in IIT between India and Thailand, while indicating the scope for deepening the integration further by tariff reforms, reduction of non-tariff barriers and improvements in trade facilitation. The cointegration analyses of Singh (2014) underlined that improvement in institutional parameters causes both short run and long run improvements in bilateral trade and IIT. Interestingly, recent studies conducted at HS 6-digit level underline rising importance of both VIIT (Srivastava and Medury, 2011) and HIIT (Kelkar and Burange, 2016) across product categories in the Indian context. Finally, importance of FDI inflows on IIT level in India has been noted (Burange et al., 2017).

However, analysis on determinants of India's composite IIT with respect to major trade partners, particularly involving the RTA partners, is a relatively less researched area in recent period. Moreover, the research on determinants of India's sectoral IIT, particularly in light of sector-level variables, remains scarce. To bridge this gap, the present research intends to understand the determinants of India's composite as well as sectoral IIT (for seven key manufacturing categories), namely - chemicals, leather and footwear, textile and garments, iron and steel, base metals, electrical and electronics machinery and equipment and automobile products, with major trade partners over 2001-15.

Analysis of India's Trade and Intra-Industry Trade Indices: 2001-2019

The analysis first computes the average share of India's major trade partners in the trade basket. Next, it summarizes India's average IIT levels with respect to the selected countries in our analysis, followed by graphical representation of India's composite IIT with ROW over 2001-2019. The evolving shares of the seven selected product categories, in India's export and import baskets are reported in the subsequent analysis. Finally, the bilateral sectoral IIT indices between India and the selected trade partners over 2001-05 and 2011-15 are reported.

The evolving export and import partnership of India with the 25 major trading partners are reported in Table 1. For observing the temporal perspective, their average shares in India's export and import baskets are compared during 2001-05, 2006-10, 2011-15 and 2016-19 respectively. It is observed that in the export basket, the share of these countries have gradually declined over the study period from 68.41 percent to 61.58 percent. Conversely, on the import front, their share has increased from 55.77 percent to 65.04 percent over the same period. On the whole, the analysis covers the major trade partners of India, barring United Arab Emirates (henceforth UAE) and Iraq, which accounts for around 10 percent of India's trade with the World. These two countries have been dropped from the analysis due to non-availability of data on various explanatory variables included in the empirical model, e.g., Per Capita GDP, Labour and Capital Stock.

Table 1: Average shares of India's major trade partners in the trade basket

No.	Country	Export Share (%)				Import Share (%)			
		2001-05	2006-10	2011-15	2016-19	2001-05	2006-10	2011-15	2016-19
1	Australia	0.90	0.75	0.87	1.12	2.93	3.63	2.49	2.67
2	USA	18.50	12.51	12.98	16.12	6.38	6.41	4.87	6.27
3	China	4.41	6.46	4.67	4.58	5.30	10.66	12.52	15.35
4	Indonesia	1.47	1.61	1.67	1.35	2.26	2.38	3.20	3.36
5	Japan	2.97	2.11	1.95	1.49	3.22	2.53	2.37	2.55
6	Korea	1.24	1.89	1.43	1.44	2.86	2.76	2.88	3.40
7	Iran	1.14	1.22	1.18	0.97	0.43	3.80	2.28	2.10
8	South Africa	1.01	1.46	1.62	1.27	2.51	1.70	1.63	1.41
9	UK	4.78	3.80	3.06	3.00	4.11	1.88	1.35	1.24
10	Qatar	0.20	0.29	0.30	0.41	0.34	1.29	3.00	2.00
11	Malaysia	1.43	1.53	1.50	1.87	2.23	2.24	2.19	2.15
12	Thailand	1.25	1.06	1.12	1.27	0.77	0.98	1.22	1.48
13	Sri Lanka	1.77	1.51	1.66	1.45	0.24	0.19	0.15	0.20
14	Germany	3.82	3.14	2.54	2.74	3.83	3.81	2.97	2.81
15	Switzerland	0.73	0.36	0.40	0.38	4.91	4.71	5.59	3.97
16	Netherlands	2.06	3.05	2.64	2.32	0.77	0.66	0.55	0.64
17	Singapore	3.53	4.46	4.02	3.34	2.47	2.62	1.66	2.42
18	Hong Kong	4.95	3.96	4.24	4.40	1.60	1.69	1.73	2.89
19	Vietnam	0.62	0.95	1.65	2.18	0.06	0.15	0.53	1.23
20	Bangladesh	2.22	1.43	1.73	2.48	0.09	0.11	0.13	0.19
21	Brazil	3.02	2.48	2.03	1.07	0.57	0.66	1.00	0.92
22	Belgium	0.72	1.40	1.83	2.04	4.90	2.08	2.22	1.81
23	Italy	2.66	2.27	1.63	1.73	1.34	1.40	1.02	1.02
24	Nigeria	0.93	0.79	0.89	0.85	0.10	2.93	2.96	2.10
25	France	2.08	1.85	1.70	1.71	1.55	1.68	0.80	0.87
	Total	**68.41**	**62.34**	**59.31**	**61.58**	**55.77**	**62.95**	**61.31**	**65.04**

Source: Own computation from Trade Map (ITC, undated) data

Table 2 summarizes India's average IIT levels with respect to the selected countries. To view the results in wider perspective, the countries are arranged separately in accordance with their developmental status. In addition, the FTA partnership status of the selected countries is also indicated. For observing the temporal perspective, the average IIT values are compared over 2001-05, 2006-10, 2011-15 and 2016-19.

Table 2: India's aggregate Intra-Industry Trade results for top trade partners

Country	Intra Industry Trade Index				Partnership / Negotiations with India through Trade Bloc	Status
	2001-05	2006-10	2011-15	2016-19		
Developed Economies						
Australia	11.25	12.84	7.69	7.30	FTA, RCEP	Under Negotiations
Belgium	62.88	50.72	51.98	52.06	India-EU BTIA	Under Negotiations
France	19.42	22.82	33.19	35.32	India-EU BTIA	Under Negotiations
Germany	25.57	35.39	40.10	41.81	India-EU BTIA	Under Negotiations
Hong Kong, SAR	60.05	64.29	57.84	34.86		No FTA
Italy	27.85	24.12	30.87	31.99	India-EU BTIA	Under Negotiations
Japan	13.03	18.05	19.56	29.17	IJCEPA, RCEP	CEPA, Under Negotiations
Netherlands	23.91	24.88	25.49	25.56	India-EU BTIA	Under Negotiations
Qatar	1.22	7.11	15.11	4.93	GCC FTA	FA signed
Singapore	21.19	48.41	39.44	29.26	ISCECA, IASEAN CECA, RCEP	CECA, Under Negotiations
South Korea	17.71	29.90	38.03	43.76	APTA, IKCEPA, RCEP	PTA, CEPA, Under Negotiations
Switzerland	36.86	43.54	36.10	34.17	India-EFTA Agreement	Under Negotiations
UK	18.22	25.85	27.53	34.68	India-EU BTIA	Under Negotiations
USA	31.21	26.63	29.82	34.77		No FTA
Developing Economies						
Bangladesh	12.66	16.85	22.74	22.07	SAFTA, BIMSTEC	FTA, Under Negotiations
Brazil	6.69	10.28	7.76	12.50	India Mercosur PTA, IBSA	PTA
China	15.07	15.12	20.36	27.64	APTA, RCEP	PTA, Under Negotiations
Indonesia	11.74	14.36	13.22	26.09	IASEAN CECA, RCEP, IICECA	CECA, Under Negotiations
Iran	9.00	9.35	3.43	3.50	GSTP, PTA	PTA, Under Negotiations
Malaysia	19.03	22.63	24.01	20.50	IMCECA, IASEAN CECA, RCEP	CECA, Under Negotiations
Nigeria	7.56	0.53	0.47	0.45	GSTP	PTA
South Africa	4.97	5.64	3.97	4.50	IBSA, SACU PTA	Under Negotiations

Sri Lanka	29.80	30.77	43.33	45.95	ISLFTA, APTA, BIMSTEC	FTA, APTA, Under Negotiations
Thailand	20.35	25.61	30.29	34.11	IASEAN CECA, RCEP, FTA, BIMSTEC	CECA, Under Negotiations
Vietnam	10.55	16.04	12.87	12.59	IASEAN CECA, RCEP	CECA, Under Negotiations

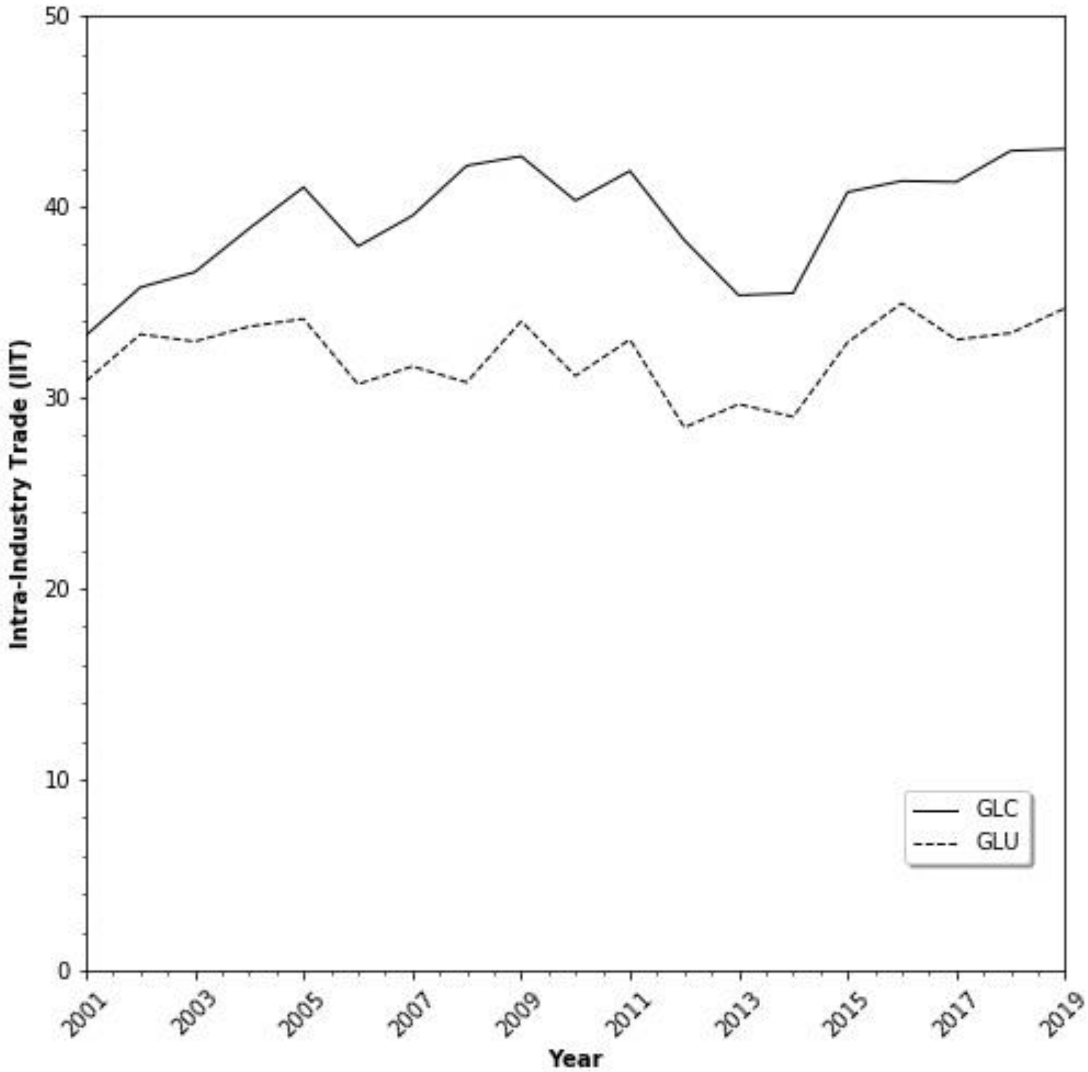
Source: Own computation from Trade Map (ITC, undated) data and information drawn from ADB (undated)

A mixed pattern is observed in India's IIT level with *developed* economies. For EU members, IIT has generally shown an upward trend. It is expected that once the ongoing Bilateral Trade and Investment Agreement (henceforth BTIA) comes into effect, it will significantly enhance trade in general and IIT in particular. For Hong Kong, which has no current FTA link with India, substantial fall in IIT has been noticed. Interestingly, India's IIT with Singapore and Japan, the comprehensive trade partners, have increased after formation of the preferential trade agreement (henceforth PTA), indicating greater volume of trade within commodity groups. Since the analysis is conducted at the overall level, it might not capture all the sectoral dynamics, e.g., explaining the declining IIT for Australia. IIT for the remaining developed economies have generally shown an upward trend over the years.

Growth in IIT figures with respect to several *developing* economies has been observed which can be generally attributed to their preferential trade agreements with India. China, South Africa, Nigeria and Iran are exceptions to this trend. The weaker IIT with Iran can be attributed to the economic sanctions, while the same for South Africa and Nigeria can be explained by political and structural undercurrents. For instance, the average IIT with Nigeria over 2006-10 and 2016-19 dropped to 0.53 and 0.45 respectively.

The analysis then computes India's composite IIT with ROW over 2001-19, reporting both GLU and GLC indices in Figure 1. It is observed that at the composite level, India's IIT has witnessed a fluctuating trend. While the IIT level increased over 2001-05, it fluctuated at regular intervals over 2005-19. However, over 2014-19, an increasing trend has been noted. On the whole, the GLC index has increased from 33.25 to 43.03 over 2001 to 2019. In other words, the rise in India's overall IIT has been moderate, despite the tariff reforms and significant increase in the country's trade integration with the world.

Figure 1: India's overall Intra-Industry Trade with ROW (2001-2019)



Source: Own construction from Trade Map (ITC, undated) data

Since the present study undertakes a country-level analysis of India with its major trading partners, henceforth GLC index is used as a measurement criterion for calculation of IIT.

Next, the evolving shares of the seven selected product categories, in India's export and import baskets are reported in Table 3. The corresponding HS 2-digit codes under each product category are noted in the second column of the Table 3. For observing the temporal perspective, their average shares are compared over 2001-05, 2006-10, 2011-15 and 2016-19 respectively. The proportional shares of these product groups witnessed fluctuations over the study period, and a falling and rising trend emerges for export and import baskets of the country respectively. It is observed that in the export basket, the share of these commodities have declined from 46.67 percent to 43.17 percent over 2001-05 to 2016-19. The corresponding numbers on the import front are 30.64 and 34.29 percent in that order. The dynamics on export front can be explained by export diversification of India's trade basket, e.g., rise in the shares of petroleum (HS 27) and gems of jewellery (HS 71) products. On the whole the seven sectors, which are characterized by simultaneous export and import, account for a substantial proportion of India's trade.

Table 3: Importance of the selected commodities in India's exports and imports basket

Sector	HS Codes	Average Export Share (%)				Average Import Share (%)			
		2001-05	2006-10	2011-15	2016-19	2001-05	2006-10	2011-15	2016-19
Chemicals	28, 29	4.83	4.97	4.50	5.57	5.53	4.53	4.72	5.60
Leather and Footwear	41, 42, 64	3.65	2.20	1.99	2.02	0.38	0.25	0.28	0.38
Textile and Garments	50-63	20.71	13.46	12.11	12.21	2.44	1.29	1.20	1.56
Iron and Steel	72, 73	6.08	6.59	5.08	5.30	3.32	4.48	3.54	3.28
Base Metals	74-83	2.33	3.31	2.58	3.00	1.96	2.00	2.26	3.06
Electrical and Electronics Machinery and Equipment	84, 85	6.52	8.01	7.47	9.51	16.35	17.19	14.5	19.16
Vehicles and Auto-components	87	2.55	3.32	4.32	5.55	0.66	0.95	1.08	1.23
Total		**46.67**	**41.86**	**38.06**	**43.17**	**30.64**	**30.69**	**27.59**	**34.29**

Source: Own computation from Trade Map (ITC, undated) data

The bilateral sectoral IIT indices between India and the selected trade partners over 2001-05, 2006-10, 2011-15 and 2016-19 are reported in Tables 4, 5, 6 and 7 respectively. Since the present study also undertakes a sectoral-level analysis of India with its major trading partners, henceforth Aquino index is used for measuring IIT. Interestingly, India's average IIT indices for several country-sector combinations declined during 2011-15 vis-à-vis the corresponding 2001-05 level, despite rise in bilateral trade flows. For instance, India's average IIT with China in automobile product segment during 2001-05 and 2011-15 are 62.01 and 53.69 respectively. The apparent fallacy can be explained by the fact that during 2001-05 both India's export and import were at a low level, resulting in a moderate IIT index. However, with gradual rise in both export and import, the divergence between the two series at HS 4-digit level has significantly gone up, resulting in a lower IIT at sectoral level in recent years. The declining value of sectoral IIT indices in several cases therefore can be explained with deepening specialization in narrower product lines, rather than weakening participation of of the country in IPNs. The last columns of Tables 4, 5, 6 and 7 summarize the RTA relationship status between India and the selected countries. It is observed that in recent period, the geographical coverage of India's RTA strategy has increased considerably. In the empirical analysis, the year-wise RTA dummies have been constructed accordingly.

Table 4: India's average sectoral Intra-Industry Trade pattern with select trade partners (2001-05)

Country	Sector							Partnership / Negotiations with India through Trade Bloc	Status
	Chemicals	Leather and Footwear	Textile and Garments	Iron and Steel	Base Metals	Electrical and Electronics Machinery and Equipment	Vehicles and Auto-components		
Developed Economies									
Australia	27.20	9.69	0.99	18.38	8.54	34.62	76.36		No FTA
Belgium	38.37	18.66	8.33	29.02	10.72	29.14	52.08		No FTA
France	42.35	23.47	7.72	24.47	24.83	41.33	49.07		No FTA
Germany	44.98	24.22	6.87	32.48	30.75	43.64	76.03		No FTA
Hong Kong, SAR	38.18	36.21	20.21	17.59	26.88	24.63	54.16		No FTA
Italy	43.07	33.70	18.56	26.63	25.38	43.22	36.04		No FTA
Japan	43.76	32.42	8.67	22.83	23.37	41.78	78.03		No FTA
Netherlands	36.04	11.54	3.30	28.15	13.33	28.07	22.89		No FTA
Qatar	27.58	0	4.87	5.676	1.67	6.98	2.50		No FTA
Singapore	37.49	41.14	14.70	26.39	18.51	40.30	75.55	IASEAN CECA, ISCECA	FA Signed, CECA
South Korea	39.02	36.15	5.17	26.72	16.80	30.50	63.35	APTA	PTA
Switzerland	45.61	22.07	10.52	29.83	20.50	38.98	26.34		No FTA
UK	40.14	11.11	13.06	20.58	14.47	55.24	59.00		No FTA
USA	36.14	11.65	6.20	36.28	27.01	52.39	68.68		No FTA
Developing Economies									
Bangladesh	0.18	17.71	2.94	1.66	4.12	14.38	9.76	APTA, SAFTA, BIMSTEC	PTA, FA signed
Brazil	8.22	41.04	5.87	18.00	2.79	24.27	22.59	India Mercosur PTA	FA Signed
China	39.23	31.59	11.79	18.04	17.82	28.67	62.01	APTA	PTA
Indonesia	28.90	37.47	17.25	35.07	19.26	17.29	40.51	IASEAN CECA	FA Signed
Iran	14.70	15.45	3.80	16.01	12.43	10.95	52.78		No FTA
Malaysia	45.79	46.64	7.74	18.88	11.59	37.58	63.58	IASEAN CECA	FA Signed
Nigeria	15.59	5.90	1.82	2.21	2.08	11.15	8.15	GSTP	PTA
South Africa	7.86	40.06	3.99	8.28	2.61	18.02	52.82	SACU PTA	FA Signed
Sri Lanka	7.14	35.47	32.60	11.60	20.97	20.39	23.17	APTA, ISLFTA, SAFTA, BIMSTEC	PTA, FTA, FA signed
Thailand	34.45	18.87	17.25	16.93	14.03	28.79	68.54	IASEAN CECA, FTA, BIMSTEC	FA Signed
Vietnam	18.24	6.12	19.43	8.05	0.91	9.14	24.32	IASEAN CECA	FA Signed

Source: Own computation from Trade Map (ITC, undated) data and information drawn from ADB (undated)

Table 5: India's average sectoral Intra-Industry Trade pattern with select trade partners (2006-10)

Country	Sector							Partnership / Negotiations with India through Trade Bloc	Status
	Chemicals	Leather and Footwear	Textile and Garments	Iron and Steel	Base Metals	Electrical and Electronics Machinery and Equipment	Vehicles and Auto-components		
Developed Economies									
Australia	13.02	5.90	0.92	19.03	13.76	35.04	43.51		No FTA
Belgium	32.73	24.97	11.71	44.82	16.71	36.65	51.07	India-EU BTIA	Under Negotiations
France	39.94	32.32	19.60	29.13	21.94	54.65	52.23	India-EU BTIA	Under Negotiations
Germany	46.82	27.62	9.96	27.80	37.07	48.29	78.61	India-EU BTIA	Under Negotiations
Hong Kong, SAR	43.10	18.82	18.09	11.68	11.84	41.57	50.64		No FTA
Italy	40.49	35.93	27.62	22.19	25.45	46.17	41.36	India-EU BTIA	Under Negotiations
Japan	41.36	37.42	6.11	7.98	19.83	43.13	84.81	IJCEPA	Under Negotiations
Netherlands	36.20	7.93	5.49	14.61	14.06	30.71	22.31	India-EU BTIA	Under Negotiations
Qatar	17.18	15.08	22.02	5.14	5.78	21.18	3.77	GCC FTA	FA signed
Singapore	48.95	46.60	18.48	38.74	20.65	49.17	22.49	IASEAN CECA, ISCECA	CECA
South Korea	29.13	18.37	5.45	13.63	19.52	33.66	68.89	APTA, IKCEPA	PTA, CEPA
Switzerland	42.01	31.72	13.60	26.04	21.88	38.28	28.56	India-EFTA Agreement	Under Negotiations
UK	41.18	16.18	26.87	24.48	13.50	52.36	68.92	India-EU BTIA	Under Negotiations
USA	37.37	13.42	9.52	27.23	32.80	48.54	65.90		No FTA
Developing Economies									
Bangladesh	1.38	24.01	4.52	2.77	2.95	13.77	12.24	SAFTA, BIMSTEC	FTA, FA signed
Brazil	13.96	11.61	7.17	19.25	8.12	31.47	57.11	India Mercosur PTA	PTA
China	34.95	14.86	5.98	11.67	7.89	39.00	41.16	APTA	PTA
Indonesia	45.31	14.68	12.33	24.25	10.03	22.62	34.02	IASEAN CECA	CECA
Iran	9.88	1.05	3.19	20.94	12.78	13.07	71.86		No FTA
Malaysia	36.65	21.85	8.42	14.09	21.40	28.56	56.82	IMCECA, IASEAN CECA	Under Negotiations, CECA
Nigeria	3.64	0.63	0.61	2.24	1.25	6.67	6.51	GSTP	PTA
South Africa	5.03	22.53	3.56	14.64	6.51	27.97	31.86	SACU PTA	Under Negotiations
Sri Lanka	7.24	23.85	39.69	14.64	18.43	22.88	6.13	APTA, ISLFTA, SAFTA, BIMSTEC	APTA, FTA, FA signed
Thailand	25.17	38.65	14.01	21.75	7.49	27.68	83.60	IASEAN CECA, FTA, BIMSTEC	CECA, FA signed
Vietnam	9.98	4.69	8.51	13.39	9.96	16.03	22.63	IASEAN CECA	CECA

Source: Own computation from Trade Map (ITC, undated) data and information drawn from ADB (undated)

Table 6: India's average sectoral Intra-Industry Trade pattern with select trade partners (2011-15)

Country	**Sector**							**Partnership / Negotiations with India through Trade Bloc**	**Status**
	Chemicals	**Leather and Footwear**	**Textile and Garments**	**Iron and Steel**	**Base Metals**	**Electrical and Electronics Machinery and Equipment**	**Vehicles and Auto-components**		
Developed Economies									
Australia	6.45	4.93	1.08	7.73	5.79	46.43	19.46	FTA, RCEP	Under Negotiations
Belgium	29.89	15.12	11.94	52.61	11.17	37.99	66.70	India-EU BTIA	Under Negotiations
France	45.10	27.40	16.04	34.84	25.89	53.31	52.30	India-EU BTIA	Under Negotiations
Germany	56.33	30.73	10.59	37.14	41.99	57.65	85.62	India-EU BTIA	Under Negotiations
Hong Kong, SAR	46.24	16.25	17.70	14.76	26.71	61.46	45.06		No FTA
Italy	55.01	45.00	34.07	34.55	29.76	47.15	52.44	India-EU BTIA	Under Negotiations
Japan	37.75	44.89	8.36	12.60	22.32	46.22	85.92	IJCEPA, RCEP	CEPA, Under Negotiations
Netherlands	38.98	16.91	7.47	8.84	8.53	36.92	17.40	India-EU BTIA	Under Negotiations
Qatar	13.78	15.36	19.93	10.46	0.88	24.26	12.05	GCC FTA	FA signed
Singapore	35.70	44.70	18.06	24.84	40.74	44.83	7.42	ISCECA, IASEAN CECA, RCEP	CECA, Under Negotiations
South Korea	30.97	27.26	15.22	11.18	25.16	45.56	92.93	APTA, IKCEPA, RCEP	PTA, CEPA, Under Negotiations
Switzerland	45.74	40.44	20.04	29.03	24.82	39.01	45.73	India-EFTA Agreement	Under Negotiations
UK	46.78	20.74	28.26	20.34	10.58	56.79	84.67	India-EU BTIA	Under Negotiations
USA	43.02	21.24	11.90	33.49	28.30	52.26	68.42		No FTA
Developing Economies									
Bangladesh	3.26	38.46	7.42	5.29	10.58	20.45	8.45	SAFTA, BIMSTEC	FTA, Under Negotiations
Brazil	19.87	10.13	7.15	24.91	20.31	47.07	77.48	India Mercosur PTA, IBSA	PTA
China	36.98	18.35	6.56	19.09	4.32	46.91	53.69	APTA, RCEP	PTA, Under Negotiations
Indonesia	28.38	23.83	20.44	24.58	8.33	26.76	57.38	IASEAN CECA, RCEP, IICECA	CECA, Under Negotiations
Iran	8.04	0.73	4.02	18.91	5.25	16.59	24.91	GSTP	PTA
Malaysia	22.64	28.25	14.88	15.24	23.82	31.86	37.58	IMCECA, IASEAN CECA, RCEP	CECA, Under Negotiations
Nigeria	6.80	0.24	1.65	2.64	1.56	14.43	21.99	GSTP	PTA
South Africa	7.40	14.01	2.55	6.35	3.31	16.84	20.20	IBSA, SACU PTA	Under Negotiations
Sri Lanka	13.93	26.16	32.63	21.71	30.96	28.32	14.94	ISLFTA, SAFTA, APTA, BIMSTEC	FTA, PTA, Under Negotiations
Thailand	24.98	28.87	19.64	20.82	20.99	40.73	85.06	IASEAN CECA, RCEP, FTA, BIMSTEC	CECA, Under Negotiations
Vietnam	11.06	2.07	16.13	21.46	11.80	13.87	11.15	IASEAN CECA, RCEP	CECA, Under Negotiations

Source: Own computation from Trade Map (ITC, undated) data and information drawn from ADB (undated)

Table 7: India's average sectoral Intra-Industry Trade pattern with select trade partners (2016-19)

Country	Sector							Partnership / Negotiations with India through Trade Bloc	Status
	Chemicals	Leather and Footwear	Textile and Garments	Iron and Steel	Base Metals	Electrical and Electronics Machinery and Equipment	Vehicles and Auto-components		
Developed Economies									
Australia	3.76	5.80	0.82	20.38	7.35	44.18	27.76	FTA, RCEP	Under Negotiations, India left
Belgium	43.85	29.16	16.54	42.71	15.00	38.79	71.62	India-EU BTIA	Under Negotiations
France	43.28	31.66	15.35	42.59	30.34	58.88	48.77	India-EU BTIA	Under Negotiations
Germany	53.55	29.50	9.59	48.73	42.11	57.28	66.84	India-EU BTIA	Under Negotiations
Hong Kong, SAR	50.76	28.79	20.50	16.75	33.68	63.56	70.02		No FTA
Italy	52.70	39.39	29.39	33.71	18.68	48.54	46.82	India-EU BTIA	Under Negotiations
Japan	34.24	46.93	9.22	23.28	11.51	47.37	71.85	IJCEPA, RCEP	CEPA, India left
Netherlands	49.48	30.65	10.57	25.23	7.67	47.57	36.44	India-EU BTIA	Under Negotiations
Qatar	13.74	30.42	20.22	17.37	1.39	21.22	11.01	GCC FTA	FA signed
Singapore	30.46	65.05	10.48	31.26	12.51	35.54	33.98	ISCECA, IASEAN CECA, RCEP	CECA, India left
South Korea	31.66	40.97	17.58	25.20	26.19	41.48	90.42	APTA, IKCEPA, RCEP	PTA, CEPA, India left
Switzerland	51.37	62.57	18.48	34.23	17.19	49.91	27.98	India-EFTA Agreement	Under Negotiations
UK	35.50	27.06	27.47	30.30	9.39	61.34	82.32	India-EU BTIA	Under Negotiations
USA	40.24	21.73	7.36	37.43	20.04	56.18	64.75		No FTA
Developing Economies									
Bangladesh	3.58	32.19	6.87	16.60	9.53	24.92	1.25	SAFTA, BIMSTEC	FTA, Under Negotiations
Brazil	17.07	10.93	1.89	32.30	16.74	48.77	77.48	India Mercosur PTA, IBSA	PTA
China	35.14	24.25	12.05	27.20	5.08	38.27	61.23	APTA, RCEP	PTA, India left
Indonesia	22.93	37.20	22.58	42.40	6.00	31.68	30.51	IASEAN CECA, RCEP, IICECA	CECA, India left, Under Negotiations
Iran	6.84	0.38	1.99	25.93	3.56	21.06	21.84	GSTP, PTA	PTA, Under Negotiations
Malaysia	11.55	31.79	21.04	28.00	25.16	27.25	46.70	IMCECA, IASEAN CECA, RCEP	CECA, Under Negotiations, India left
Nigeria	3.46	0.01	0.11	13.73	1.74	7.37	31.48	GSTP	PTA
South Africa	6.89	20.05	4.48	19.67	3.64	12.05	11.12	IBSA, SACU PTA	Under Negotiations
Sri Lanka	15.89	49.90	31.17	20.32	27.44	25.52	9.78	ISLFTA, APTA, BIMSTEC	FTA, APTA, Under Negotiations
Thailand	30.39	37.39	16.58	29.83	21.44	34.84	91.29	IASEAN CECA, FTA, BIMSTEC, RCEP	CECA, Under Negotiations, India left
Vietnam	2.56	9.11	14.74	17.06	17.76	17.70	54.15	IASEAN CECA, RCEP	CECA, Under Negotiations, India left

Source: Own computation from Trade Map (ITC, undated) data and information drawn from ADB (undated)

Empirical Analysis on Determinants of India's Bilateral Composite Intra-Industry Trade

Methodology and Data

A total of 25 countries are selected for the analysis. India's bilateral IIT indices over 2001-19 for the selected countries are computed through GLC method for analyzing the determinants of India's composite IIT. The time period for the analysis, 2001-15, has been limited by data availability. While export and import data from which IIT index is computed, are available upto 2019, certain key independent variables that need to be constructed (*e.g.,* state of technology difference, proxied by capital-labour ratio), data points beyond 2015 are still not available. In standard literature, overlapping trade can be modelled as the difference of per capita GDP and difference of capital-labour ratio (Cole and Elliott, 2003). In addition to this, several control variables have been incorporated in the current model such as weighted distance and interaction term of Logistic Performance Index of India with the partner nations. The inclusion of these variables in the current analysis led to the IIT centric type-model as better trade facilitation measures, *including development of infrastructure, lower cost of transportation of parts and components*, enhances gains from trade (Kumar and Ahmed, 2015; Aggarwal and Chakraborty, 2017). Finally, the following panel data model is estimated to explore the determinants of India's bilateral IITs over 2001-15:

$$LIIT_{it} = \alpha_0 + \beta_1 LDPCGDP_{it} + \beta_2 LD\left(\frac{K}{L}\right)_{it} + \beta_3 LWDIST_{it} + \beta_4 L(LPI_i LPI_j) + \beta_5 BORDER + \beta_6 LANGUAGE + \beta_7 FTA + \beta_8 INCOME + YearD_t + CountryD_i + \varepsilon_0 \quad \text{........ (3)}$$

where,

α	represents the *constant* term
βs	are *coefficients*
L	represents logarithmic transformation of the variables
IIT_{it}	represents GLC between India and country *i* for year *t*
$DPCGDP_{it}$	represents difference of Per Capita GDP between India and country *i* for year *t*
$D(K/L)_{it}$	represents difference of Capital-Labour ratio between India and country *i* for year *t*
$WDIST_{it}$	represents weighted distance between India and country *i* for year *t*

$DIST_{it}$	represents geographical distance between the capital of India and the capital of country *i* for year *t*
LPI_iLPI_j	represents an interaction term of the LPI of India and country *i* for year *t*
BORDER	represents a dummy variable which takes a value of 1 if India share a common border with country *i* and 0 otherwise
LANGUAGE	represents a dummy variable which takes a value of 1 if India and the partner country share a common language (English) with country *i* and 0 otherwise
FTA	represents a dummy variable which takes a value of 1 if India shares an RTA with country *i* and 0 otherwise
INCOME	represents PCGNI (atlas method, current US$) of country *i* for year *t*, where
LIC	represents the low income country (*PCGNI*: US$1,005 or less) dummy, which has a value of 1 for the corresponding countries and 0 otherwise.
LMIC	represents the lower-middle income country (*PCGNI*: US$1,006 - 3,975) dummy, which has a value of 1 for the corresponding countries and 0 otherwise
UMIC	represents the upper-middle income country (*PCGNI*: US$3,976-12,275) dummy, which has a value of 1 for the corresponding countries and 0 otherwise
HIC	represents the high income country (*PCGNI*: US$12,276 or more) dummy, which has a value of 1 for the corresponding countries and 0 otherwise
$YearD_t$	represents year dummies
$CountryD_i$	represents country dummies
ε_{it}	represents the error term

The regression model uses logarithmic transformation of the variables, so that the estimated coefficients can be interpreted as relevant elasticities. India's bilateral *IIT*, calculated through GLC method, is considered as the dependent variable for the analysis.

The Difference in Per Capita GDP (*DPCGDP*) has been considered as a key independent variable in the analysis. According to Linder (1961), the countries with comparable per capita incomes tend to have similar demand patterns for differentiated goods. Hence, rising difference in per capita income would imply a greater disparity in the demand structure, which would be reflected in higher levels of VIIT and vice versa (Bojnec and Fertő, 2016). Difference in Capital-labour Ratio (*DKL*) of India with select trading partners has also been incorporated in the model. As vertically differentiated products differ in terms of factor intensities and unit production costs, higher DKL implies higher VIIT (Andresen, 2003).

The literature notes that IIT is negatively correlated with geographical distance, as transportation and insurance costs increase with distance (Türkcan, 2011). The traditional gravity models generally consider geographical distance between the capitals of two countries or the distance between the major trade centres. However, one problem with this approach is that the distance remains constant throughout the period of empirical analysis. To tackle this concern, in line with existing literature (Türkcan and Ates, 2010), the present analysis considers income weighted distance (*WDIST*) between trading partners as an independent variable:

$$WDIST_{it} = \frac{DIST_i * GDP_{it}}{\sum_{i=1}^{25} GDP_{it}}$$

where, $DIST_i$ represents the direct distance in km. between the India's capital and the respective trading partners' capital. GDP_{it} represents the GDP of partner i in year t. The incorporation of income weighted distance in our model serves as an improvement over the traditional gravity model.

Since the Singapore Ministerial (1996) meeting of WTO, the countries are discussing possible improvement in trade facilitation, which covers customs procedure, timeliness of operations, port and transport infrastructure etc. A rich empirical literature exists on the influence of trade facilitation on export promotion (Djankov et al., 2010; Martí et al., 2014; Puertas et al., 2014; Martí and Puertas, 2017, 2019). In the current context trade facilitation has been proxied with LPI published by the World Bank and an interaction effect of LPI of India and the respective trading partners has been included in the model (Saslavsky and Shepherd, 2012). The interaction effect of LPI serves as the proxy for Trade Facilitation scenario prevailing in both countries and is expected to positively influence bilateral IIT. The inclusion of all these explanatory variables highlights the IIT perspective in our model. Further, it has been noted in the literature that similar income countries tend to have higher share of intra-industry trade (Linder, 1961; Lundberg, 1982; Veeramani, 2009; Bagchi and Bhattacharyya, 2019).

Finally, a few dummy variables are included in the analysis in line with the gravity literature. First, a geographic proximity (Border) dummy is included which takes the value of 1 if India shares border with a trading partner and 0 otherwise. A common border is expected to increase the intensity of IIT. Second, an ease of trade (Language) dummy is included which takes the value of 1 if English is the common language and 0 otherwise. A commonality of language is expected to promote commercial exchange in general and IIT in particular. Third, a trade preference (FTA) dummy is included which takes the value of 1 if India is engaged with a trading partner through an RTA and 0 otherwise. An FTA is expected to increase the intensity of IIT, as tariff preference and trade facilitation measures incorporated therein enhances the ease of bilateral trade (Kumar and Ahmed, 2015), including sourcing of raw materials, parts and components etc. Fourth, a development (Income) dummy is included in the analysis to understand which type of IIT dominates India's trade with partners lying within various income groups. The dummy takes a value of 1 for LICs and LMICs, while is it 0 for UMICs and HICs. It is expected that India may exhibit HIIT with the former group, while getting engaged in VIIT with the latter. Finally, year and country dummies have been incorporated in the analysis. The description of the variables used in the empirical analysis and the data sources are summarized in Annexure 1.

Given the time period (2001-2015) and various sectors, *i.e.,* having relatively large N, fixed T asymptotic, with the centered and rescaled test statistic being N (0,1), a balanced panel data is estimated here. In order to avoid spurious results, there is a need for controlling of non-stationarity in the dataset (Baltagi, 2005; Pesaran, 2015; Bagchi and Bhattacharyya, 2019). Table 8 reports the Harris-Tzavalis Test (1999), which has a null of unit root versus an alternative with a single stationary value, is performed to detect the presence of unit root among the explanatory variables. All the variables used in the regression analysis are found to be stationary. In addition, the endogeneity check for the explanatory variables has been performed in the analysis using two-stage least squares method. It is observed that Wald chi-square test statistic of 104.76 (Prob: 0.00) is statistically significant. The null hypothesis of the Durbin and Wu-Hausman tests is that the variable under consideration can be treated as exogenous. Durbin score of 3.55936 (Prob 0.0592) and Wu-Hausman statistic is 3.53429 (Prob 0.0610) are not significant, so null hypothesis of exogeneity is not rejected. Therefore, it can be noted that explanatory variables used in the panel data analysis such as, difference of Per Capita GDP, difference of Capital-Labour ratio, weighted distance and interaction of the LPI are not endogenous.

Table 8: Harris-Tzavalis–Type Panel Unit Root Test Statistic for determinants of India's bilateral composite Intra-Industry Trade

Variables	Rho	Z
LIIT	0.6441	-3.8048***
$LDPCGDP_i$	-0.4403	-30.2705***
LD(K/L)	0.3178	-11.7679***
$LogLPI_iLPI_j$	-0.0432	-20.5784***
LWDIST	0.0517	-18.2630***
LDISTANCE	0.0000	-19.5252***

Source: Own estimation using Stata: Release 14

[1]Notes: *** denotes the statistical significance at 0.01 respectively.

Empirical Findings

The summary statistics for the variables selected for the empirical analysis is provided in Table 9. Panel data regression analysis has been undertaken with help of STATA Software (version 14). Hausman test is first conducted and it suggests the presence of underlying random effect model. Lagrange Multiplier (henceforth LM) Test is then performed to detect the presence of first order autocorrelation (henceforth AR1). It is observed that chi-square test statistic of 193.39 (Prob: 0.0000) is statistically significant. Breusch-Pagan / Cook-Weisberg test for heteroscedasticity has been conducted to check the existence of heteroscedasticity in the estimated model. The Chi-square test statistic is 57.99 (Prob 0.0000). Estimated mean variance inflation factor (henceforth VIF) is 4.89 and so for all the variables, and the values of VIF are within the tolerance limit of multicollinearity. We have conducted FGLS method with time specific random effects. The estimated model makes correction for the existence of heteroscedasticity and AR1 within balanced panel data framework. To test whether unobserved

[1] In addition to Harris-Tzavalis-Type Panel Unit Root Test, the current analysis has also performed Levin-Lin-Chu (2002) and Fisher-type (Choi, 2001) Panel Unit Root Tests, which has a null of unit root versus an alternative with a single stationary value. The results are in line with Harris-Tzavalis-Type Panel Unit Root Test. Therefore, only the Harris-Tzavalis Test has been reported.

components that create interdependencies across cross sections are correlated with included regressors, Pesaran (2004) Cross-section Dependence (henceforth CD) test has been performed in R software. The null hypothesis of the CD test states that the residuals are cross-sectionally uncorrelated. Correspondingly, the alternative hypothesis presumes that spatial dependence is present. Observed F-statistic of 5.12 (Prob: 0.00) indicates that null hypothesis of spatial independence at 5% level of significance is rejected. Therefore, standard fixed-effects and random effects estimators will be biased and inconsistent. Based on the diagnostic tests, the present analysis adopts Panel Corrected Standard Errors (henceforth PCSE) method as it allows for accurate estimation of variability in the presence of time series cross-section analysis error structures (Beck and Katz, 1995). The baseline empirical estimates are summarized in Table 10 wherein model (1-6) represents FGLS results and model (7-9) represents PCSE results. Since the logarithmic transformations are used on both sides, the estimated coefficients can be interpreted as relevant elasticities.

Table 9: Summary Statistics for determinants of India's bilateral composite Intra-Industry Trade

Variable	Observation	Mean	Std. Dev.	Min	Max
LIIT	350	1.22	0.43	-0.59	1.89
$LDPCGDP_i$	350	3.92	0.89	0.54	4.98
LD(K/L)	350	2.04	0.58	-0.02	2.73
$LogLPI_iLPI_j$	350	1.02	0.07	0.85	1.11
LWDIST	350	1.65	0.80	0.03	3.54
BORDER	350	0.12	0.32	0.00	1.00
LANGUAGE	350	0.32	0.46	0.00	1.00
LDISTANCE	350	3.51	0.26	2.94	3.97
LDC	350	0.20	0.40	0.00	1.00
FTA	350	0.30	0.46	0.00	1.00

Source: Own estimation

Several conclusions emerge from the empirical results. First, the coefficient of DPCGDP is positive and significant in several models, indicating that with growing difference in income level, the IIT rises, but in less than proportionate manner. Second, the coefficient of D(K/L) also is positive and significant in several models, indicating that with growing difference in technology level, bilateral IIT increases. The results for DPCGDP and D(K/L), taken together, indicate presence of VIIT in India's trade pattern with the select partners. Third, both WDIST and DIST variables are found to be negative and significant, in line with the theoretical predictions. Fourth, the LPI interaction term is positive and significant for all model specifications, indicating that one percent improvement in trade facilitation both in India and the partner country leads to a more than proportionate increase in India's IIT level with that partner. This can be attributed to the improving trade facilitation scenario. Fifth, the coefficient of border dummy is positive and significant; indicating that sharing a land border may promote IIT, as movement of parts and components is facilitated. Sixth, the coefficient of the language dummy is negative and significant, signifying that India's IIT may be relatively higher with non-English speaking nations. The result can be attributed to India's rising IIT with countries like China, Japan, South Korea, and several EU members (Germany, France) etc. in recent period. Finally, the FTA dummy is not found to be significant. The result can be explained by the fact that India is enjoying higher IIT index with a number of developed countries, which are presently not among India's FTA partners (e.g., Belgium, Germany, UK, USA).

Since the sign and significance of explanatory variables are in line with theoretical expectations using both the methods. Therefore, we have adopted FGLS method for robustness check and the results are summarized in Table 11. First, the regression model in equation (3) has been estimated by dividing the 25 sample countries in two income-oriented groups, with LICs and LMICs in one group and UMICs and HICs on the other. The results are reported in models 7 and 8 respectively. A couple of interesting observations emerge from the analysis. First, for both groups, the coefficient of the DPCGDP variable is positive and significant, but the coefficient is higher for the latter group. In other words, with higher-income countries, the income level difference may increase the IIT more, further underlining the presence of VIIT-type trade. Second, D(K/L) is however found non-significant for both groups. Third, the WDIST variable is negative and significant for low-income countries, while it is non-significant for the higher-income group. The result can be explained by the presence of similar IIT levels for countries such as Germany, Singapore and South Korea in the latter group, which are geographically situated at varying distance. Fourth, interestingly the trade facilitation variable is found to be non-significant for the low-income countries but positive and significant for the high-income countries. The result implies that improvement in trade facilitation scenario in both the partners would significantly enhance India's IIT level for higher-income countries. On the other hand India's bilateral IIT involving low-income countries, characterized by limited differentiation in manufacturing export basket, may not change, even in the presence of improved trade facilitation. Fifth, the border dummy is not significant for both group of countries, which deviates from the baseline results. Sixth, the language dummy is negative and significant for both group of countries, in line with the pooled regression models. Finally, the FTA dummy is not significant for both the groups in line with the earlier results.

The stability analysis is also conducted by estimating model 9, where first difference for all the continuous variables has been considered. The regression results show that difference in LIIT is directly related to difference in capital-labour ratio and significant. Interestingly, the WDIST variable is found to be positive and significant, given the fact that India's IIT is displaying an increasing trend with high growing economies. Model 10 uses LIIT as the dependent variable and it is observed that countries having historically high level of IIT are expected to continue along the trend line. The WDIST variable is found to be negative in line with expectation. The difference in capital-labour ratio is negative and significant owing to the fact that with large year-on-year difference in the same, IIT may come down with simultaneous rise in inter-industry type trade. The results indicate that estimated models are robust and signs and level of significance of the coefficients are stable.

Table 10: Regression results on determinants of India's bilateral Intra-Industry Trade

Independent Variables	Dependent Variable: LIIT								
	Model (1)	Model (2)	Model (3)	Model (4)	Model(5)	Model(6)	Model(7)	Model(8)	Model(9)
	FGLS Method						PCSE Method[2]		
Constant	-0.630	-0.816**	-1.132***	-0.062	-1.164***	0.328*	-2.777***	-2.818***	-0.340*
	(0.489)	(0.420)	(0.424)	(0.534)	(0.406)	(0.174)	(0.277)	(0.291)	(0.323)
LDPCGDP	0.124*	0.058	0.082	0.068	0.074	0.128**	0.391*	0.417*	0.180*
	(0.070)	(0.048)	(0.061)	(0.059)	(0.058)	(0.062)	(0.080)	(0.083)	(0.058)
LD(K/L)	0.065	0.260*	0.228**	0.214**	0.216**	0.268**	0.700***	0.729***	0.304***
	(0.082)	(0.108)	(0.096)	(0.092)	(0.094)	(0.109)	(0.134)	(0.136)	(0.106)
$L(LPIi*LPI_j)$	1.432***	1.462***	1.586***	1.596***	1.815***		3.990***	4.009***	3.545***
	(0.484)	(0.471)	(0.482)	(0.468)	(0.473)		(0.310)	(0.323)	(0.303)
LWDIST	-0.082**	-0.067**	-0.084**		-0.093***	-0.035	-0.009*	-0.005	
	(0.048)	(0.036)	(0.049)		(0.035)	(0.028)	(0.032)	(0.031)	
LDIST				-0.263***					-0.555***
				(0.102)					(0.075)
Border		0.423***	0.368***	0.248**	0.403***	0.405***	0.684***	0.627***	
		(0.116)	(0.118)	(0.124)	(0.120)	(0.128)	(0.056)	(0.062)	
Language			-0.127***	-0.108***	-0.114***	-0.064	-0.051*	-0.021*	
			(0.036)	(0.044)	(0.042)	(0.043)	(0.041)	(0.036)	
FTA					-0.024	-0.038		0.110	
					(0.032)	(0.032)		(0.052)	
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	375	375	375	375	375	375	375	375	375
F-Statistics	48.69	59.05	72.91	73.48	78.16	68.72	87.32	72.48	78.18

Note: Figure in the parenthesis shows the autocorrelation and heteroscedasticity-corrected standard errors of the estimated coefficient.
***, **, and * implies estimated coefficient is significant at 0.01, 0.05, and 0.10 level, respectively.

Source: Own estimation

[2] It may be noted no systematic difference has been observed between the two methodologies (FGLS and PCSE), hence we have reported only the main models of PCSE results.

Table 11: Robustness check results on determinants of India's bilateral Intra-Industry Trade

Independent Variables	Dependent Variable: LIIT		Independent Variables	Dependent Variable: DLIIT	Independent Variables	Dependent Variable: LIIT
	Model(7): LICs and LMICs	Model (8): UMICs and HICs		Model (9)		Model (10)
Constant	-0.232	-1.368***	Constant	-0.006	Constant	0.582***
	(1.049)	(0.512)		(0.008)		(0.042)
LDPCGDP	0.137*	0.234**	DLDPCGDP	0.048	LIIT(t-1)	0.587***
	(0.069)	(0.122)		(0.052)		(0.038)
LD(K/L)	0.342	-0.012	DLD(K/L)	0.395**	DLDPCGDP	(0.001)
	(0.241)	(0.136)		(0.194)		(0.112)
L(LPIi*LPI$_j$)	1.128	1.752***	DL(LPIi*LPI$_j$)	0.718	DLD(K/L)	-0.630*
	(1.132)	(0.572)		(0.832)		(0.352)
LWDIST	-0.260**	-0.032	DLWDIST	0.424*	DL(LPIi*LPI$_j$)	0.024
	(0.169)	(0.036)		(0.252)		(1.532)
LDIST					DLWDIST	-1.272***
						(0.464)
Border	0.056	0.143				
	(0.186)	(0.142)				
Language	-0.628**	-0.091**				
	(0.324)	(0.042)				
FTA	-0.114	0.004				
	(0.075)	(0.041)				
Year Dummies	Yes	Yes		Yes		Yes
Country Dummies	Yes	Yes		Yes		Yes
N	75	300		375		375
F-Statistics	64.89	52.36		11.43		81.96

Note: Figure in the parenthesis shows the autocorrelation and heteroscedasticity-corrected standard errors of the estimated coefficient.
∗∗∗, ∗∗, and ∗ implies estimated coefficient is significant at 0.01, 0.05, and 0.10 level, respectively.

Source: Own estimation

The above analysis in the present chapter observed the empirical analysis on determinants of India's bilateral composite IIT with respect to 25 major trade partners that constitutes more than 60% of India's trade with respect to ROW. It has been noted that driving factors such as income difference, technology difference and trade facilitation essentially influence India's bilateral composite IIT with major trade partners. Recently, the extensive literature on determinants of IIT notes that analysis at sectoral level has come up as another branch of research. Therefore, the current chapter extends the empirical analysis of India's IIT to sectoral level. Following section examines the empirical findings for factors influencing India's bilateral IIT at sectoral level. The selected sectors include - chemicals, leather and footwear, textile and garments, iron and steel, base metals, electrical and electronics machinery and equipment and automobile products.

Empirical Analysis on Determinants of India's Bilateral Sectoral Intra-Industry Trade

Methodology and Data

The present study first identifies the major sectors in the Indian context, which experience simultaneous export and imports. The goal is to select product groups which represent a significant share in India's trade basket. Seven major manufacturing product groups are selected for this purpose based on their share in India's exports and imports. The selected sectors collectively account for more than 40 percent of India's export and import flows. Second, India's major trade (i.e., export and import) partners are selected on the basis of their share in the country's trade basket. A total of 25 countries are selected for the analysis, who collectively account for around 60 percent of India's export and import flows. The idea for selecting this group of products and countries is that the sample is representative of India's overall trade pattern. The time period is limited by data availability, as for several independent variables, data points beyond 2015 is still not available. Also, in Prowess firm level database, data for several firms from 2016 onwards has not been updated. Third, India's bilateral sectoral IIT indices for the selected countries are computed over 2001-15 using the Aquino index as mentioned in equation (2). Aquino index has been selected over GLC because of the trade imbalance present in several country-product group combinations. For instance, in electrical equipment (HS 85) sector India suffers from a trade deficit with respect to China consistently in all 4-digit headings. Therefore, for comparability, Aquino index has been computed for all trade partners over the sample period.

Growing IIT level in a country depicts the increasing trade of intermediate and semi-process as well as final products within an industry group with global partners. While India has witnessed a rise in bilateral trade flows and IIT in manufacturing segments since 2005, the much expected integration of the domestic industrial sector with the IPNs and GVCs are yet to deepen (Ray and Miglani, 2018). The IPN participation of a country might be influenced by several drivers, namely - country-level (e.g., technology difference), industry-level (e.g., productivity) and institutional (trade costs, trade agreements) ones. In this context, the current section intends to identify the major drivers for India's bilateral sectoral IITs in select manufacturing segments with key trade partners. Finally, the following panel data model is estimated to explore the determinants of India's sectoral bilateral IITs over 2001-15:

$$LIIT_{ijt} = \alpha_0 + \beta_1 LDPCGDP_{it} + \beta_2 LD\left(\frac{K}{L}\right)_{it} + \beta_3 LWDIST_{it} + \beta_4 L\big(LPI_i LPI_j\big) + \beta_5 FTA\left(L\big(LPI_i LPI_j\big)\right) + \beta_6 TARIFFLINE_{jt} + \beta_7 ALP_{jt} + W_t + +\varepsilon_{it} \quad \text{........ (4)}$$

where,

α	represents the *constant* term
βs	are *coefficients*
L	represents logarithmic transformation of the variables
IIT_{ijt}	represents bilateral sectoral Aquino index measuring IIT between India and country *i* for sector *j* in year *t*
$DPCGDP_{it}$	represents difference of Per Capita GDP between India and country *i* for year *t*
$D(K/L)_{it}$	represents difference of Capital-Labour ratio between India and country *i* for year *t*
$WDIST_{it}$	represents weighted distance between India and country *i* for year *t*
LPI_iLPI_j	represents an interaction term of the Logistics Performance Index (LPI) of India and country *i* for year *t*
$FTA*L(LPI_iLPI_j)$	represents an interaction term of the FTA dummy and Logistics Performance Index (LPI) of India and country *i* for year t

$TARIFFLINE_{jt}$	represents vertical product differentiation between India and the rest of the world for sector *j* in year *t*
ALP_{jt}	represents average labour productivity in Indian industries for sector *j* in year *t*
W_t	represents a set of dummy variables (e.g., common border and language, FTA) which takes a value of 1 if India satisfy a particular relationship with country *i* and 0 otherwise
ε_{it}	represents the error term

Logarithmic transformation of the variables has been undertaken here, so that the estimated coefficients can be interpreted as relevant elasticities. Table 10 reports the Harris-Tzavalis Test (1999), which has a null of unit root versus an alternative with a single stationary value, is performed to detect the presence of unit root among the explanatory variables. All the variables used in the regression analysis for chemicals sector, as reported in Table 12, are found to be stationary. In addition, the endogeneity check for the explanatory variables has been performed in the analysis using two-stage least squares method. It is observed that Wald chi-square test statistic of 133.97 (Prob: 0.00) is statistically significant. The null hypothesis of the Durbin and Wu-Hausman tests is that the variable under consideration can be treated as exogenous. Durbin score of 2.48222 (Prob 0.1151) and Wu-Hausman statistic is 2.45709 (Prob 0.1179) are not significant, so null hypothesis of exogeneity is not rejected. Similarly, the stationarity and endogeneity check has also been conducted for the rest of the sectors in our analysis. Therefore, it can be noted that explanatory variables used in the panel data analysis such as, difference of Per Capita GDP, difference of Capital-Labour ratio, weighted distance, interaction of the LPI, Average Labour Productivity (henceforth ALP) and vertical product differentation are not endogenous.

Table 12: Harris-Tzavalis–Type Panel Unit Root Test Statistic for determinants of India's bilateral sectoral Intra-Industry Trade

Variables	Rho	Z
LIIT	0.4587	-8.3309***
LDPCGDP$_i$	-0.4403	-30.2705***
LD(K/L)	0.3178	-11.7679***
LogLPI$_i$*LPI*$_j$	-0.0432	-20.5784***
LWDIST	0.0517	-18.2630***
FTA(LogLPI$_i$*LPI*$_j$*)*	-0.0219	-19.3462***
TARIFFLINE	0.4742	-7.9286***
ALP	0.4913	-7.5340***

Source: Own estimation using Stata: Release 14

[3]Notes: *** denotes the statistical significance at 0.01 respectively.

India's bilateral sectoral *IITs*, calculated through Aquino method, is considered as the dependent variable. The description of the variables used in the empirical analysis and the data sources are summarized in Annexure 2. First, in line with gravity literature (Baldwin and Taglioni, 2011), a few country-level variables are considered. Difference in Per Capita GDP (*DPCGDP*) has been included as a key independent variable following Linder hypothesis, which states that countries similar in terms of per capita incomes also tend to have similar demand patterns for differentiated product categories (Linder, 1961). Conversely, rising difference in per capita income underlines growing difference in demand structure, reflected in higher levels of VIIT and vice versa (Bojnec and Fertő, 2016). Difference in Capital-labour Ratio (*DKL*) between India and selected countries are also included in the model, as higher DKL enhances VIIT among partners (Cole and Elliott, 2003). These independent variables are computed from World Bank (undated a) and Federal Reserve Economic Database (henceforth FRB, undated).

Traditional gravity models consider geographical distance between the capitals of two countries or the distance between the major ports as a negative factor influencing IIT. However, the consequent constant distance between the two partners over the study period may influence

[3] In addition to Harris-Tzavalis-Type Panel Unit Root Test, the current analysis has also performed Levin-Lin-Chu (2002) and Fisher-type (Choi, 2001) Panel Unit Root Tests, which has a null of unit root versus an alternative with a single stationary value. The results are in line with Harris-Tzavalis-Type Panel Unit Root Test. Therefore, only the Harris-Tzavalis Test has been reported.

the results. Following the literature (Türkcan and Ates, 2010), *WDIST* between trading partners is instead considered as an independent variable in the current context:

$$WDIST_{jt} = \frac{DIST_j * GDP_{jt}}{\sum_{j=1}^{25} GDP_{jt}}$$

where, $DIST_j$ represents the direct distance in km. between the India's capital and the respective trading partners' capital. GDP_{jt} represents the GDP of partner j in year t. The variable is computed with Distance Calculator (undated) and World Bank (undated a) resources.

Second, to understand the influence of the industry-level drivers on bilateral IIT indices, a few variables are incorporated in the model. Number of commodities (at HS 6-digit level) traded between India and partner for sector j (Tariffline) has been included as a key independent variable, as vertical product differentiation positively influences IIT (Manrique, 1987; Tharakan and Kerstens, 1995; Veeramani, 2007). The analysis use Tarrifline noted from TradeMap as a proxy for vertical trade differentiation in line with literature. ALP across the select sectors is also included in the model. ALP has been computed as the ratio of total sales divided by total number of employees in a particular sector. A higher productivity strengthens the competitiveness in the international market and therefore, may enhance IIT (Elliott and Brulhart, 2002; Melitz, 2003). Firm level data for this purpose across seven sectors has been taken from Prowess database, Centre for Monitoring Indian Economy (henceforth CMIE, undated).

Third, the model also measures the importance of the institutional (i.e., the ones reflected through trade costs) drivers on bilateral IIT level. To reduce trade costs, over the past decade countries are embracing various trade facilitation measures, e.g., simplification of customs procedure, improvements in timeliness of operations, port and transport infrastructure etc. The positive influence of trade facilitation on exports (Martí et al., 2014; Puertas et al., 2014; Martí and Puertas, 2017, 2019) as well as export diversification (Dennis and Shepherd, 2011) has been empirically observed. India has undertaken a number of trade facilitation initiatives in the recent period, covering both gateway and behind-the-border measures (Banerjee, 2017; De, 2014). The present analysis use LPI prepared by the World Bank as a proxy of trade facilitation in line with the literature. An interaction effect of LPI of India *(LPI_k)* and the respective trading partners *(LPI_j)* has been included in the model, as improved trade facilitation scenario prevailing in both countries is expected to positively influence bilateral trade flows and thereby sectoral IIT (Saslavsky and Shepherd, 2012). The LPI index has been obtained from World Bank (undated b).

Apart from the aforesaid variables, a few dummy variables are also included in line with the gravity literature (Baldwin and Taglioni, 2011). First, a geographic proximity (Common Border) dummy is used which takes the value of 1 if India shares border with partner i and 0 otherwise. A common border is expected to reduce trade cost, thereby positively influencing IIT. Second, an ease of trade (Language) dummy is considered which takes the value of 1 if English is primarily spoken in partner i and 0 otherwise. A commonality of language is expected to facilitate business interactions and thereby IIT. Third, a trade partnership (FTA) dummy is included which takes the value of 1 if India has an RTA with a country and 0 otherwise. Given the tariff preference and trade facilitation measures incorporated in the commitments, an FTA is expected to augment bilateral trade flows and thereby IIT (Kumar and Ahmed, 2014).

Finally, an interaction term $FTA*(LPI_k LPI_i)$ has also been included in the model, where a positive relationship is expected. Improved trade facilitation (better infrastructure and connectivity, reflected through improving LPI) coupled with tariff reforms (resulting from deepened RTA cooperation between India and trade partner (i), captured by $FTA*(LPI_k LPI_i)$, may significantly increase participations in IPNs and GVCs, and thereby influence IIT positively.

To check the robustness of the result, the selected trade partners of India are segregated in two groups in terms of their development profile i.e., Per Capita Gross National Income (henceforth PCGNI). The income classification of India's trade partners selected for the analysis in a particular year has been assigned on the basis of the World Bank definitions (World Bank, undated c) on their PCGNI levels - low income countries (LICs, *PCGNI*: US$1,005 or less), lower-middle income countries (LMICs, *PCGNI*: US$1,006 - 3,955), upper-middle income countries (UMICs, *PCGNI*: US$3,956-12,235) and high income countries (HICs, *PCGNI*: US$12,236 or more). It can be argued that India is likely to have a HIIT relationship with LICs and LMICs, while VIIT is expected with respect to the higher income countries (Srivastava and Medury, 2011; Aggarwal and Chakraborty, 2017).

Empirical Findings

Panel data regression analysis has been undertaken with help of STATA Software. Hausman test is first conducted and it suggests the presence of underlying random effect model. LM Test, Breusch-Pagan / Cook-Weisberg test and estimated mean VIF are taken into account to detect the presence of AR1, existence of heteroscedasticity and multicollinearity respectively. To test whether unobserved components that create interdependencies across cross sections are correlated with included regressors, Pesaran (2004) CD test has been performed in R software. The null hypothesis of the CD test states that the residuals are cross-sectionally uncorrelated. Correspondingly, the alternative hypothesis presumes that spatial dependence is present. Observed F-statistic of 2.68 (Prob: 0.1716) indicates that null hypothesis of spatial independence at 5% level of significance is not rejected. Based on the diagnostic tests, the present analysis adopts FGLS method with time-specific random effects. The estimated model makes correction for the existence of heteroscedasticity and AR1 within balanced panel data framework. The empirical estimates for the seven sectors are summarized in left-hand side of Tables 13 – 19. Since the logarithmic transformations are used on both sides, the estimated coefficients can be interpreted as relevant elasticities. The robustness check results are summarized in right-hand side of Tables 13 – 19.

Table 13: Regression results on determinants of Intra-Industry Trade in India's Chemical sector trade

Independent Variables	Baseline Regressions				Diagnostic Tests	
	Dependent Variable: LIIT					
	Model (1)	Model (2)	Model (3)	Model (4)	Model (5): LICs and LMICs	Model(6): UMICs and HICs
Constant	-0.924**	-1.256	1.395***	-1.181	0.526	-3.296***
	(0.477)	(0.864)	(0.298)	(1.241)	(0.490)	(0.561)
LDPCGDP	0.047	0.336***			0.270	
	(0.074)	(0.026)			(0.227)	
LD(K/L)	0.104		0.418***	0.223	0.546	0.192***
	(0.120)		(0.158)	(0.226)	(0.479)	(0.052)
$L(LPI_k*LPI_i)$	1.803***			1.750*		2.985***
	(0.536)			(1.357)		(0.319)
LWDIST	0.058**		0.740**	0.053***	2.078***	0.021*
	(0.029)		(0.170)	(0.073)	(0.825)	(0.020)
Border	0.115					0.338***
	(0.167)					(0.085)
Language	-0.086**	-0.114**		-0.096		-0.177***
	(0.039)	(0.049)		(0.109)		(0.029)
FTA		0.174			0.053	0.025*
		(0.054)			(0.670)	(0.035)
$FTA(L(LPI_k*LPI_i))$			0.076*			
			(0.057)			
Tariffline		0.006*		0.001*		0.005***
		(0.004)		(0.003)		(0.002)
ALP			0.005*		0.016	
			(0.006)		(0.016)	
F-Statistics	55.24	54.75	26.90	45.98	39.65	35.93
LM Test	166.60					
Breusch-Pagan Test	290.43					
VIF	4.89					
N	375	375	375	375	75	300

Note: Figure in the parenthesis shows the autocorrelation and heteroscedasticity-corrected standard errors of the estimated coefficient.
∗∗∗, ∗∗, and ∗ implies estimated coefficient is significant at 0.01, 0.05, and 0.10 level, respectively.

Source: Own estimation

Table 14: Regression results on determinants of Intra-Industry Trade in India's Leather and Footwear sector trade

Independent Variables	Baseline Regressions				Diagnostic Tests	
	Dependent Variable: LIIT					
	Model (1)	Model (2)	Model (3)	Model (4)	Model (5): LICs and LMICs	Model(6): UMICs and HICs
Constant	-2.267***	-2.085***	-0.535	0.723	-0.973	-0.890
	(0.059)	(0.440)	(0.452)	(0.616)	(0.737)	(0.858)
LDPCGDP	0.322	0.398*				-0.397
	(0.081)	(0.082)				(0.190)
LD(K/L)	0.483***	0.590***	0.381***	0.389***	0.764***	0.428***
	(0.127)	(0.128)	(0.051)	(0.052)	(0.287)	(0.180)
L(LPI_k*LPI_i)	4.368***	4.269***				2.500***
	(0.546)	(0.538)				(0.934)
LWDIST	0.042	0.078**	0.118***	0.105***	0.120	0.087
	(0.038)	(0.039)	(0.034)	(0.034)	(0.236)	(0.043)
Border	0.746***	0.636***	0.547***	0.692***	0.702***	
	(0.092)	(0.096)	(0.101)	(0.091)	(0.212)	
Language	-0.131***	-0.078*	-0.033		-0.279	-0.146***
	(0.053)	(0.055)	(0.055)		(0.472)	(0.048)
FTA		0.209***				0.146***
		(0.063)				(0.054)
FTA(L(LPI_k*LPI_i))			0.188***			
			(0.067)			
Tariffline	0.002		0.007*	0.005*	0.008*	0.004*
	(0.004)		(0.005)	(0.006)	(0.007)	(0.002)
ALP				0.014**		0.004
				(0.007)		(0.004)
F-Statistics	26.63	29.02	16.97	19.10	40.70	35.09
LM Test	111.55					
Breusch-Pagan Test	85.57					
VIF	4.89					
N	375	375	375	375	75	300

Note: Figure in the parenthesis shows the autocorrelation and heteroscedasticity-corrected standard errors of the estimated coefficient.
∗∗∗, ∗∗, and ∗ implies estimated coefficient is significant at 0.01, 0.05, and 0.10 level, respectively.

Source: Own estimation

Table 15: Regression results on determinants of Intra-Industry Trade in India’s Textile and Garments sector trade

Independent Variables	Baseline Regressions				Diagnostic Tests	
	Dependent Variable: LIIT					
	Model (1)	Model (2)	Model (3)	Model (4)	Model (5): LICs and LMICs	Model(6): UMICs and HICs
Constant	-1.762***	-1.730***	-1.689***	-0.307	-1.832	-0.648
	(0.514)	(0.511)	(0.512)	(0.604)	(2.060)	(0.651)
LDPCGDP					0.066	0.287***
					(0.139)	(0.074)
LD(K/L)	0.089*	0.094*	0.097*	0.303***	1.727***	
	(0.074)	(0.074)	(0.074)	(0.083)	(0.486)	
$L(LPI_k*LPI_i)$	2.644***	2.524***	2.488***			
	(0.627)	(0.624)	(0.627)			
LWDIST	-0.117***	-0.099***	-0.101***	-0.099***	-1.401***	-0.107***
	(0.040)	(0.040)	(0.040)	(0.032)	(0.345)	(0.040)
Border	0.296***	0.173*	0.199*	0.279**	-1.062***	0.202
	(0.098)	(0.108)	(0.106)	(0.134)	(0.346)	(0.149)
Language	-0.215***	-0.180***	-0.184***		0.280	-0.003
	(0.060)	(0.061)	(0.061)		(0.630)	(0.053)
FTA		0.181***				
		(0.070)				
$FTA(L(LPI_k*LPI_i))$			0.159**	0.075*	0.138	0.058
			(0.068)	(0.046)	(0.152)	(0.051)
Tariffline				0.001*	0.002	0.001
				(0.007)	(0.002)	(0.002)
ALP				0.008*	0.027	0.139**
				(0.006)	(0.025)	(0.007)
F-Statistics	11.46	10.81	10.57	27.46	32.45	26.16
LM Test	100.97					
Breusch-Pagan Test	53.94					
VIF	4.89					
N	375	375	375	375	75	300

Note: Figure in the parenthesis shows the autocorrelation and heteroscedasticity-corrected standard errors of the estimated coefficient.
∗∗∗, ∗∗, and ∗ implies estimated coefficient is significant at 0.01, 0.05, and 0.10 level, respectively.

Source: Own estimation

Table 16: Regression results on determinants of Intra-Industry Trade in India's Iron and Steel sector trade

Independent Variables	Baseline Regressions				Diagnostic Tests	
	Dependent Variable: LIIT					
	Model (1)	Model (2)	Model (3)	Model (4)	Model (5): LICs and LMICs	Model(6): UMICs and HICs
Constant	-0.167	-0.227	0.132	0.767	0.565*	0.410*
	(0.473)	(0.483)	(0.233)	(0.239)	(0.661)	(0.253)
LDPCGDP	0.086	0.068			0.295**	0.091
	(0.086)	(0.088)			(0.131)	(0.120)
LD(K/L)	0.170	0.201*	0.489***	0.223***	1.812***	0.158
	(0.118)	(0.123)	(0.097)	(0.058)	(0.341)	(0.167)
L(LPI_k*LPI_i)	0.585	0.636		1.457***		
	(0.562)	(0.570)		(0.495)		
LWDIST	0.080***	0.084***		0.126***	-1.377***	0.094***
	(0.028)	(0.029)		(0.032)	(0.252)	(0.036)
Border	0.131	0.114	0.048	0.070	-1.602***	0.117
	(0.125)	(0.128)	(0.218)	(0.086)	(0.260)	(0.179)
Language	-0.097***	-0.092***	-0.062	-0.121***	0.966***	-0.064
	(0.034)	(0.034)	(0.134)	(0.048)	(0.344)	(0.041)
FTA		0.045		0.055	0.297*	
		(0.051)		(0.057)	(0.165)	
FTA(L(LPI_k*LPI_i))			0.112**			0.003
			(0.058)			(0.053)
Tariffline				0.006*	0.022*	
				(0.007)	(0.018)	
ALP			0.001	0.002*	0.007*	
			(0.004)	(0.005)	(0.013)	
F-Statistics	71.51	69.59	33.82	21.66	17.51	29.37
LM Test	74.05					
Breusch-Pagan Test	110.38					
VIF	4.89					
N	375	375	375	375	75	300

Note: Figure in the parenthesis shows the autocorrelation and heteroscedasticity-corrected standard errors of the estimated coefficient.
∗∗∗, ∗∗, and ∗ implies estimated coefficient is significant at 0.01, 0.05, and 0.10 level, respectively.

Source: Own estimation

Table 17: Regression results on determinants of Intra-Industry Trade in India's Base Metals sector trade

Independent Variables	Baseline Regressions				Diagnostic Tests	
	Dependent Variable: LIIT					
	Model (1)	Model (2)	Model (3)	Model (4)	Model (5): LICs and LMICs	Model(6): UMICs and HICs
Constant	-2.334***	-2.317***	-1.287	-1.997**	-0.530**	-1.886*
	(0.458)	(0.457)	(0.924)	(0.998)	(0.263)	(1.034)
LDPCGDP			-0.062	-0.119		
			(0.087)	(0.092)		
LD(K/L)	0.145**	0.148**	0.455***	0.529***	1.812***	0.284***
	(0.066)	(0.066)	(0.132)	(0.138)	(0.375)	(0.067)
$L(LPI_k*LPI_i)$	2.752***	2.687***				
	(0.559)	(0.559)				
LWDIST	0.128***	0.138***	0.233***	0.240***	-1.047***	0.307***
	(0.036)	(0.036)	(0.038)	(0.038)	(0.315)	(0.036)
Border	0.379***	0.313***	0.359***	0.393***	-0.629**	
	(0.087)	(0.097)	(0.102)	(0.103)	(0.315)	
Language	-0.086*	-0.067*	0.026	0.031	1.244***	0.069
	(0.053)	(0.054)	(0.057)	(0.056)	(0.424)	(0.053)
FTA		0.097*				
		(0.063)				
$FTA(L(LPI_k*LPI_i))$			0.139**	0.112*	0.296	0.124**
			(0.066)	(0.068)	(0.243)	(0.063)
Tariffline				0.006*	0.016*	0.006*
				(0.003)	(0.009)	(0.003)
ALP				0.008*	0.010	0.004
				(0.004)	(0.011)	(0.004)
F-Statistics	33.43	28.37	19.99	18.04	7.43	16.00
LM Test	109.18					
Breusch-Pagan Test	68.20					
VIF	4.89					
N	375	375	375	375	75	300

Note: Figure in the parenthesis shows the autocorrelation and heteroscedasticity-corrected standard errors of the estimated coefficient.
∗∗∗, ∗∗, and ∗ implies estimated coefficient is significant at 0.01, 0.05, and 0.10 level, respectively.

Source: Own estimation

Table 18: Regression Results on determinants of Intra-Industry Trade in India's Electrical and Electronics Machinery and Equipment sector trade

Independent Variables	Baseline Regressions				Diagnostic Tests	
	Dependent Variable: LIIT					
	Model (1)	Model (2)	Model (3)	Model (4)	Model (5): LICs and LMICs	Model(6): UMICs and HICs
Constant	0.093	0.214***	0.580***	0.636***	0.491***	1.228**
	(0.237)	(0.760)	(0.089)	(0.076)	(0.141)	(0.547)
LDPCGDP	0.088**		0.083**		0.098	
	(0.045)		(0.039)		(0.081)	
LD(K/L)	0.092	0.138***	0.161***	0.254***	0.436**	0.063**
	(0.060)	(0.028)	(0.060)	(0.030)	(0.202)	(0.047)
$L(LPI_k*LPI_i)$	0.698***	1.591***				1.153***
	(0.282)	(0.241)				(0.291)
LWDIST	0.073***	0.123***	0.113***	0.132***	-0.179	0.099***
	(0.014)	(0.015)	(0.016)	(0.012)	(0.112)	(0.014)
Border	0.210***	0.270***	0.210***	0.236***	-0.043	0.047*
	(0.057)	(0.042)	(0.054)	(0.047)	(0.127)	(0.061)
Language	0.002	0.002	0.041**	0.047***	0.057	0.032*
	(0.018)	(0.023)	(0.019)	(0.016)	(0.207)	(0.017)
FTA		0.059**				0.052**
		(0.028)				(0.023)
$FTA(L(LPI_k*LPI_i))$			0.071***	0.063***	0.043	
			(0.021)	(0.021)	(0.080)	
Tariffline		0.003*				0.001*
		(0.001)				(0.001)
ALP				0.004***	0.002	0.002*
				(0.001)	(0.004)	(0.001)
F-Statistics	169.92	176.13	185.20	236.46	65.21	132.44
LM Test	35.92					
Breusch-Pagan Test	170.43					
VIF	4.89					
N	375	375	375	375	75	300

Note: Figure in the parenthesis shows the autocorrelation and heteroscedasticity-corrected standard errors of the estimated coefficient.
∗∗∗, ∗∗, and ∗ implies estimated coefficient is significant at 0.01, 0.05, and 0.10 level, respectively.

Source: Own estimation

Table 19: Regression results on determinants of Intra-Industry Trade in India's Vehicles and Auto-components sector trade

Independent Variables	Baseline Regressions				Diagnostic Tests	
	Dependent Variable: LIIT					
	Model (1)	**Model (2)**	**Model (3)**	**Model (4)**	**Model (5): LICs and LMICs**	**Model(6): UMICs and HICs**
Constant	-1.809***	-1.802***	-1.525**	-0.423	-8.407	0.915
	(0.444)	(0.445)	(0.771)	(1.978)	(4.503)	(0.620)
LDPCGDP	-0.301	-0.314				-0.136*
	(0.079)	(0.083)				(0.077)
LD(K/L)	0.258**	0.276**	0.149**	0.113**	0.736**	
	(0.126)	(0.130)	(0.091)	(0.050)	(0.339)	
$L(LPI_k*LPI_i)$	3.382***	3.365***	2.767***		4.942**	
	(0.544)	(0.545)	(0.689)		(2.478)	
LWDIST	0.303***	0.309***	0.194***	0.344***	-0.157	0.221***
	(0.038)	(0.039)	(0.036)	(0.033)	(0.270)	(0.054)
Border	0.146*	0.127*		0.038	-0.085	-0.272***
	(0.091)	(0.097)		(0.099)	(0.294)	(0.101)
Language	-0.138***	-0.129**	-0.150***	-0.089*	0.206	-0.090
	(0.053)	(0.055)	(0.043)	(0.054)	(0.384)	(0.062)
FTA		0.036*				
		(0.063)				
$FTA(L(LPI_k*LPI_i))$				0.043*		0.045
				(0.067)		(0.044)
Tariffline			0.006	0.015*	0.055	0.012*
			(0.007)	(0.026)	(0.049)	(0.007)
ALP			0.003*			0.001
			(0.001)			(0.002)
F-Statistics	37.36	32.00	85.60	22.33	62.89	26.88
LM Test	69.18					
Breusch-Pagan Test	124.90					
VIF	4.89					
N	375	375	375	375	75	300

Note: Figure in the parenthesis shows the autocorrelation and heteroscedasticity-corrected standard errors of the estimated coefficient.
∗∗∗, ∗∗, and ∗ implies estimated coefficient is significant at 0.01, 0.05, and 0.10 level, respectively.

Source: Own estimation

Several conclusions emerge from the empirical results. First, the coefficient of DPCGDP is positive and significant only in case of chemicals, leather and footwear and electrical equipment sector, indicating that with growing difference in income level, IIT rises in these sectors. However the coefficient is found to be inelastic. Second, the coefficient of D(K/L) also is positive and significant in all the model specifications. In other words, rising difference in technology level facilitates bilateral sectoral IIT. The presence of higher IIT with growing differences in technology level underlines the dominance of VIIT in India's trade pattern with the identified economies. Third, WDIST is generally found to be positive and significant, barring the exception of textile and garments sector. The apparent conflict with theoretical predictions comes from the fact India's IIT is relatively higher with European (e.g., France, Germany) and that American (e.g., USA) partners, all of which are distant vis-à-vis regional neighbours (e.g., Bangladesh) characterized by lower IITs. Besides, India is more likely to be involved in VIIT relationship with developed countries. Fourth, the LPI interaction term is positive and significant for all the model specifications. In all the product-groups the coefficient is elastic except iron and steel, indicating that one percent improvement in trade facilitation both in India and the partner country leads to a more than proportionate increase in bilateral IIT level with that partner. Fifth, the labour productivity variable is positive and significant for all sectors, indicating that rise in efficiency facilitates higher IIT. Sixth, tariffline is positive and significant for all sectors, indicating that greater product diversity creates demand for Indian varieties and hence higher IIT. Seventh, the coefficient of border dummy is generally positive and significant, barring the exception of chemicals and iron and steel sector. The result can be explained by the fact that while sharing a land border may promote IIT, in case of chemicals and iron and steel products India's IIT is relatively higher with countries that lack a common border with it (e.g., Thailand, Japan, South Korea, UK, and Germany). Here the existing RTA linkage (Thailand, Japan, and South Korea) and intra-firm network effect (UK, Germany) are likely to play bigger roles. Eighth, the coefficient of the language dummy is generally negative and significant, baring the exception of electrical and electronics products. The result shows that India's IIT is generally higher with non-English speaking countries, either due to their manufacturing sector growth (e.g., China, Germany, France), regional trade linkage (e.g., Japan, South Korea) or both. Ninth, the FTA dummy is found to be significant in all the model specification with the exception in iron and steel segment. The result can be rationalized by the fact that India is likely to have a VIIT relationship with several developed and developing countries, who presently are its RTA partners (e.g., Singapore, Brazil, China, Thailand, and Vietnam). Finally, the FTA*LPI interaction term is positive and significant, indicating that deeper trade facilitation measures in FTA partner countries are conducive for higher both-way trade and IIT. The inclusion of these variables throws light on the influence of logistics factors in enhancing both-way sectoral trade.

The robustness check results are summarized in right-hand side of Tables 13-19. Here the regression model in equation (3) has been re-estimated by dividing the sample countries in two income-oriented groups, with LICs and LMICs in one group and UMICs and HICs on the other. The results are reported in models 5 and 6 respectively. A couple of interesting observations emerge from the analysis. First, the coefficient of the D(K/L) variables is positive and significant, but the same is greater for the higher income group. The results underline the presence of India's VIIT-type trade even with the lower-income countries. Second, interestingly the trade facilitation interaction term is found to be non-significant for most of the product groups involving low-income countries, though it is positive for automobile products. On the other hand, for high-income countries the term is generally positive and significant, barring the exception of textile-garments and iron-steel, base-metals and automobiles sectors. It can be noted that while rising trade facilitation in case of developed country partners increase India's bilateral sectoral IITs, a similar relationship with developing countries is absent, presumably owing to the poorer LPI scenario therein. This raises a need to check actual trade facilitation reforms in developing countries. Third, while the relationship of the WDIST for high income countries resembles the baseline results, a negative relationship is noted for iron and steel and base metals sector involving low income countries. In other words, while growing distance may reduce India's IIT with developing countries (e.g., Brazil, Nigeria), the same with developed partners (e.g., Germany, USA), guided more by product differentiation, remains undeterred. Fourth, the border dummy is negative for textile, iron and steel and base metals, indicating India's low IIT with low-income trade partners in these categories. Fifth, the language dummy is positive and significant for low-income countries for iron-steel and base-metals products, but generally negative for high-income countries. The underlying reason is the presence of Australia in the lower extreme of India's sectoral IITs and the location of China, France and Germany at the other extreme. Sixth, the signs of ALP and tariffline are broadly in line with baseline results, barring non-significance in certain sectors. Finally, the FTA dummy is found to be positive and significant for several product groups in case of high-income countries, given the presence of Japan, Singapore and South Korea in the list.

Conclusion

India is increasingly relying on export-oriented growth strategy, and with this objective has partnered several countries through RTAs. With the launch of 'MII' initiative and the gradual deepening of the RTA partnerships with partner countries through tariff and trade facilitation reforms have enabled India to deepen its presence in Asian IPNs, resulting into simultaneous bilateral export and import flows within product categories. The ongoing trade facilitation initiatives, involving both gateway and behind-the-border measure-related reforms, have further widened the scope for value chain integration of the country across product categories. The expanding manufacturing product basket and increasing efficiency, aided by technology transfer through foreign investment related reforms as well as indigenous innovations, have greatly enhanced the potential of India's participation in the Asian IPNs. In particular, the presence of ASEAN, South Korea and Japan among India's RTA partners, the regions which are deeply integrated in Asian IPNs, have facilitated simultaneous export and import of manufacturing products given the declining tariff and non-tariff barriers. In this context the enhanced trade flows, fuelled by increasing cross-border procurement decisions by firms, have significantly influenced India's bilateral sectoral IITs. It is expected that once the RCEP negotiations are concluded, the mega-bloc would positively influence the bilateral sectoral IIT levels.

India's IIT has shown an upward trend over the study period (2001-15) with most of the developed and developing nations, and might be vertical in nature. The rising IIT can be attributed to the technology and income difference on one hand and trade facilitation measures implemented by India and its trade partners on the other. In addition, India is in the process of entering into preferential trade relationship with a number of countries across development spectrum, which is expected to reduce the border hassles further. The scenario is likely to improve further as the Trade Facilitation Agreement at WTO Bali Ministerial (2013) requires reform commitment from all members, as per their multilateral obligations. All these development are likely to influence IIT trends positively, thereby strengthening the IPNs and global value chains further.

The current article intends to analyze the trends and determinants of India's bilateral composite IIT with select trade partners. Three major conclusions emerge from the analysis. First, there is a need to introduce newer variables for explaining India's IIT with respect to its trading partners, so as to arrive at focused policy prescriptions. The literature on determinants of India's IIT with respect to trade facilitation measures is relatively unexplored. The LPI, constructed by World Bank, captures an estimate of trade facilitation in a country. In this current context, coefficient of LPI interaction variable is found to be positively and significantly influencing IIT trade pattern of India with respect to its partners in general and in relation to high income groups in particular. This indicates the need for facilitating interventions in the area of infrastructure and connectivity development, and other logistics activities both through unilateral and multilateral routes for further promotion of trade. Second, it also underlines the need to strengthen the economic infrastructure in low-income countries, so that the consequent product differentiation can facilitate their entry in regional IPNs. Third, the moderate level of India's IIT even with RTA partners deserves attention of the policymakers.

The current analysis further focuses on the pattern and determinants of India's bilateral sectoral level of IIT with select partner nations, yields the following policy observations. First, India's bilateral sectoral IITs display a mixed trend over the study period (2001-2015), and the declining IIT indices in recent period can be explained with deepening specialization in narrower product lines, resulting growing trade divergences in tariff headings. This also underlines a potential threat to Indian exports with respect to more efficient trade partners (e.g., China), in the post-RCEP period. The result puts in context India's cautious approach towards RCEP on one hand and stresses the importance of the success of 'MII' initiative on the other.

Second, the positive relationship between trade facilitation and bilateral IIT of India with the developed countries and absence of a similar relationship with their developing counterparts is an area of concern. This relation indicates the growing need to assess the practical aspects of trade facilitation reforms in the major developing country trade partners and the importance of infrastructure augmentation therein. Capacity formation (e.g., construction and upgradation of roads / ports) through initiatives like WTO 'Aid for Trade' provisions, both in India and the partner countries, are particularly important in this context.

Third, low levels of India's sectoral IITs even with several RTA partners is another concern area. The results indicate that deepening India's participation in global IPNs by entering into more RTAs with developing countries may not be a formidable strategy. Finally, the presence of vertical IITs in several sectors underlines that India's sectoral IITs are generally guided by technology differences, rather than by similarity of demand.

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Annexure 1: Sources of data and description of variables used in the empirical model for determinants of India's bilateral composite Intra-Industry Trade

Sl. No.	Variable	Variable Description	Data Source
1	IIT	GLC index of IIT, computed with import and export data in US '000 $ obtained from Trade Map, ITC (undated), by following Grubel and Lloyd (1975), as expressed in equation (1) of Chapter 3.	Own computation
2	DPCGDP	Difference in *Per Capita GDP* computed on the basis of data taken from the online World Development Indicator (WDI) database, which report data in US $ at current prices (World Bank, undated a).	Own computation
3	D(K/L)	Difference in K/L ratio on the basis of capital and labour data. The *Capital Stock* data is taken from Federal Reserve Economic Database (FRB, undated), which report data in US $ Mn. The *Labour Stock* data has been taken from WDI (World Bank, undated a).	Own computation
4	WDIST	Computed with the direct distance in km. between India's capital and the respective trading partners' capital (Distance Calculator, undated) and the GDP of partner countries obtained from WDI (World Bank, undated a).	Own computation
5	DIST	Measures direct distance in km. between India's capital and the respective trading partners' capital (Distance Calculator, undated).	Obtained from Distance Calculator
6	LPI_i*LPI_j	Multiplication of Logistic Performance Index (LPI) of India and partner country obtained from World Bank (undated b), which report the logistics sector performance of the countries in a 1 to 5 scale. As LPI is not a continuous series, the values have been used for appropriate years.	Own computation
7	BORDER	Countries sharing border with India has a dummy value of 1 and 0 otherwise.	Own compilation
8	LANGUAGE	Countries with national *LANGUAGE* as English have dummy value of 1 and 0 otherwise.	Own compilation
9	FTA	The information on FTA partnership of India has been collected from FTA database maintained by Asia Regional Integration Centre (ARIC), ADB (undated). An FTA partner has been assigned dummy value of 1 from the year it has come into existence and 0 otherwise.	Own compilation
10	INCOME	The dummy takes a value of 1 for LICs and LMICs, and 0 for UMICs and HICs, by considering the income ranges defined under World Bank (undated c).	Own compilation

Source: Own construction

Annexure 2: Sources of data and description of variables used in the empirical model for determinants of India's bilateral sectoral Intra-Industry Trade

Sl. No.	Variable	Variable Description	Data Source
1	IIT	Aquino index of IIT, computed with import and export data in US '000 $ obtained from Trade Map, ITC (undated), by following Aquino (1997), as expressed in equation (2) of Chapter 3.	Own computation
2	DPCGDP	Difference in *Per Capita GDP* computed with data obtained from the online World Development Indicator (WDI) database, which report data in US $ at current prices (World Bank, undated a).	Own computation
3	D(K/L)	Difference in K/L ratio on the basis of capital and labour data. The *Capital Stock* data is obtained from Federal Reserve Economic Database (FRB, undated), which report data in US $ Mn. The *Labour Stock* data has been taken from WDI (World Bank, undated a).	Own computation
4	WDIST	Computed with the direct distance in km. between India's capital and the respective trading partners' capital (Distance Calculator, undated) and the GDP of partner countries obtained from WDI (World Bank, undated a).	Own computation
5	LPI_k*LPI_j	Multiplication of Logistic Performance Index (LPI) of India (k) and partner country (i) obtained from World Bank (undated b), which report the logistics sector performance of the countries in a 1 to 5 scale. As LPI is not a continuous series, the values have been used for appropriate years.	Own computation
6	ALP	Total sales divided by total number of employees in a particular sector. Computations have been made with data obtained from Prowess database (CMIE, undated).	Own computation
7	Tariffline	Vertical Product Differentiation computed on the basis of India exports to World at HS 6 digit level obtained from Trade Map, ITC (undated)	Own compilation
8	BORDER Dummy	Countries sharing border with India has a dummy value of 1 and 0 otherwise.	Own compilation
9	LANGUAGE Dummy	Countries with national *LANGUAGE* as English have dummy value of 1 and 0 otherwise.	Own compilation
10	FTA Dummy	The information on FTA partnership of India has been collected from FTA database maintained by Asia Regional Integration Centre (ARIC), ADB (undated). An FTA partner has been assigned dummy value of 1 from the year it has come into existence and 0 otherwise.	Own compilation
11	$FTA*(L(LPI_k*LPI_i))$	Multiplication of FTA with Logistic performance index of India with partner country (LPI_k*LPI_i)	Own computation
Splicing the dataset on Development level in Diagnostic Test		The income groups are defined by Per Capita Gross National Income (PCGNI). The lower income countries include low income countries (LICs, *PCGNI*: US$1,005 or less) and lower-middle income countries (LMICs, *PCGNI*: US$1,006 - 3,955). The higher income countries include upper-middle income countries (UMICs, *PCGNI*: US$3,956-12,235) and high income countries (HICs, *PCGNI*: US$12,236 or more). The income ranges are obtained from World Bank (undated c).	Own construction

Source: Own construction

Annexure 3: TiVA – HS Concordance

Sector	TiVA Code 2018	HS Code
Textile, leather and related products	D13T15	4101-4115, 4201-4206, 5001-5007, 5101-5113, 5201-5212, 5301-5311, 5401-5408, 5501-5516, 5601-5609, 5701-5705, 5801-5811, 5901-5911, 6001-6006, 6101-6117, 6201-6217, 6301-6310, 6401-6406
Chemicals	D19T23	2801-2853, 2901-2942
Machinery and Equipment	D28	8401-8487
Electrical Equipment	D27	8501-8548
Base Metals and Iron and Steel	D24T25	7201-7229, 7301-7326, 7401-7419, 7501-7508, 7601-7616, 7801-7806, 7901-7907, 8001-8007, 8101-8113, 8201-8215, 8301-8311
Transport Equipment	D29T30	8701-8716
Sector	**TiVA Code 2016**	**HS Code**
Textile, leather and related products	C17T19	4101-4115, 4201-4206, 5001-5007, 5101-5113, 5201-5212, 5301-5311, 5401-5408, 5501-5516, 5601-5609, 5701-5705, 5801-5811, 5901-5911, 6001-6006, 6101-6117, 6201-6217, 6301-6310, 6401-6406
Chemicals	C23T26	2801-2853, 2901-2942
Machinery and Equipment	C29	8401-8487
Electrical Equipment	C30T33	8501-8548
Base Metals and Iron and Steel	C27T28	7201-7229, 7301-7326, 7401-7419, 7501-7508, 7601-7616, 7801-7806, 7901-7907, 8001-8007, 8101-8113, 8201-8215, 8301-8311
Transport Equipment	C34T35	8701-8716

Source: Own construction based on TiVA database (2018, 2016) (OECD, undated) and Trade Map (ITC, undated) classifications

Annexure 4: Product concordance between Industry and Trade Codes

Year 1998		
Sector	**NIC 4-digit code**	**HS 4-digit code**
Chemical	2411, 2412	2801-2853, 2901-2942
Leather and footwear	1911, 1912, 1920	4101-4115, 4201-4206, 6401-6406
Iron and Steel	2710, 2731, 2811, 2812, 2813, 2891, 2892, 2893	7201-7229, 7301-7326
Vehicles	3410, 3420, 3430, 3591, 3592, 3599	8701-8716
Textiles and Garments	1711, 1712, 1721, 1722, 1723, 1729, 1730, 1810, 2430	5001-5007, 5101-5113, 5201-5212, 5301-5311, 5401-5408, 5501-5516, 5601-5609, 5701-5705, 5801-5811, 5901-5911, 6001-6006, 6101-6117, 6201-6217, 6301-6310
Base Metals	2720, 2732, 2899	7401-7419, 7501-7508, 7601-7616, 7801-7806, 7901-7907, 8001-8007, 8101-8113, 8201-8215, 8301-8311
Electrical Machinery and Equipment's	2911, 2912, 2913, 2914, 2915, 2919, 2921, 2922, 2923, 2924, 2925, 2926, 2927, 2929, 2930, 3000, 3110, 3120, 3130, 3140, 3150, 3190, 3210, 3220, 3230	8401-8487, 8501-8548
Year 2004		
Sector	**NIC 4-digit code**	**HS 4-digit code**
Chemical	2411, 2412	2801-2853, 2901-2942
Leather and footwear	1911, 1912, 1920	4101-4115, 4201-4206, 6401-6406
Iron and Steel	2711, 2712, 2713, 2714, 2715, 2716, 2717, 2718, 2719, 2731,	7201-7229, 7301-7326

	2811, 2812, 2813, 2891, 2892, 2893	
Vehicles	3410, 3420, 3430, 3591, 3592, 3599	8701-8716
Textiles and Garments	1711, 1712, 1713, 1714, 1721, 1722, 1723, 1724, 1725, 1729, 1730, 1810, 2430	5001-5007, 5101-5113, 5201-5212, 5301-5311, 5401-5408, 5501-5516, 5601-5609, 5701-5705, 5801-5811, 5901-5911, 6001-6006, 6101-6117, 6201-6217, 6301-6310
Base Metals	2720, 2732, 2899	7401-7419, 7501-7508, 7601-7616, 7801-7806, 7901-7907, 8001-8007, 8101-8113, 8201-8215, 8301-8311
Electrical Machinery and Equipment's	2911, 2912, 2913, 2914, 2915, 2919, 2921, 2922, 2923, 2924, 2925, 2926, 2927, 2929, 2930, 3000, 3110, 3120, 3130, 3140, 3150, 3190, 3210, 3220, 3230	8401-8487, 8501-8548
Year 2008		
Sector	**NIC 4-digit code**	**HS 4-digit code**
Chemical	2011, 2012	2801-2853, 2901-2942
Leather and footwear	1511, 1512, 1520	4101-4115, 4201-4206, 6401-6406
Iron and Steel	2410, 2431, 2511, 2512, 2513, 2591, 2592, 2593, 2599	7201-7229, 7301-7326
Vehicles	2910, 2920, 2930, 3091, 3092, 3099	8701-8716
Textiles and Garments	1311, 1312, 1313, 1391, 1392, 1393, 1394, 1399, 1410, 1430, 1709, 2030	5001-5007, 5101-5113, 5201-5212, 5301-5311, 5401-5408, 5501-5516, 5601-5609, 5701-5705, 5801-5811, 5901-5911,

		6001-6006, 6101-6117, 6201-6217, 6301-6310
Base Metals	2420, 2432, 2599	7401-7419, 7501-7508, 7601-7616, 7801-7806, 7901-7907, 8001-8007, 8101-8113, 8201-8215, 8301-8311
Electrical Machinery and Equipment's	2610, 2620, 2630, 2640, 2660, 2710, 2720, 2731, 2732, 2733, 2740, 2750, 2790, 2811, 2812, 2813, 2814, 2815, 2816, 2817, 2818, 2819, 2821, 2822, 2823, 2824, 2825, 2826, 2829	8401-8487, 8501-8548

Source: Own construction, based on analysis with ASI data, NIC Classification (1998, 2004, 2008), MOSPI, CSO, GoI (undated) and Trade Map (ITC, undated) classifications